Quantifying forest degradation and deforestation using Geographic Information System (GIS); a case study in the three provinces, South Kalimantan, East Kalimantan and South-east Sulawesi, Indonesia

A thesis submitted in partial fulfilment
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of
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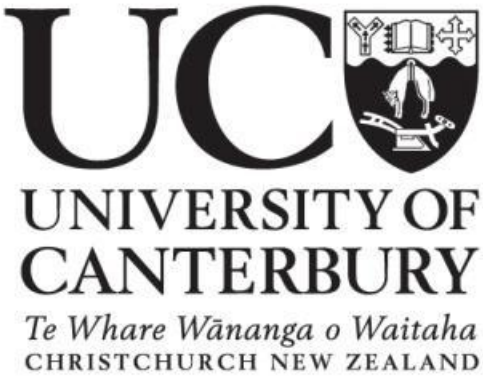
Andi Adriana We Tenri Sau



School of Forestry
University of Canterbury
New Zealand

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Abstract

Forest degradation and deforestation have been pervasive problems in Indonesia and the country is placed second in terms of a high rate of tropical deforestation. Different definitions and different techniques have been used to quantify forest degradation and deforestation in Indonesia, and different factors have been detected as direct and underlying causes. However, almost no quantitative studies have been conducted to relate deforestation and forest degradation to the causes. This study quantifies the rate of forest degradation and deforestation between 2000 and 2009 in three provinces of Indonesia, South Kalimantan, East Kalimantan and South East Sulawesi, as a case study.

A geographic information system (GIS) was used to generate geographic datasets to allow quantification; accompanied by a descriptive statistical analysis. Land cover in 2000 and 2009 was used as the basis of analysis. A national land use classification was aggregated into 10 different land use classes. Changes in land use between 2000 and 2009 allowed quantification of the rates of forest degradation and deforestation as well as the association between degradation and deforestation and potential causes.

Overall, 95% of primary forest degradation in South Kalimantan, 65% in East Kalimantan, and 46% in SE Sulawesi were associated with direct causes such as forest concessions, mining activities and the government-sponsored transmigration program. The selected direct causes explain 56% of secondary forest deforestation in South Kalimantan, 44% in East Kalimantan and 55% in SE Sulawesi.

Results of this study also show that forest degradation and deforestation occurred across the official forest areas. Almost 40% of forest degradation in South Kalimantan and East Kalimantan occurred in conservation forests and production forests respectively; while 57% of forest degradation in SE Sulawesi occurred in protected forests. Deforestation occurred 29% and 34% in the production forests of South Kalimantan and East Kalimantan respectively. In SE Sulawesi, 34% of deforestation occurred in watershed protection forests.

This study suggests that current practice in the forest resources management in Indonesia is not effective and efficient enough to mitigate and to halt forest degradation and deforestation. This is due to the lack of consistency in implementing forest land use policy, mistaken policy interventions, and non-synchronised policy between central and local governments. Policy reform is needed to conserve the remaining forest resources and mega-diversity of Indonesia.

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To Almighty God, Allah SWT, who has listened to my voice, answered my prayers, and never challenged my life beyond my capacity. “Surely with difficulty is ease. With difficulty is surely ease” (QS: Al-Insyirah:6).

List of Abbreviations

APL	*Areal Penggunaan Lain* (Other utilisation areas/non-forest areas)
APHI	*Asosiasi Pengusaha Hutan Indonesia* (Indonesian Forestry Association)
BAKOSURTANAL	*Badan Koordinasi Survey and Pemetaan Nasional* (National Coordinating for Surveying and Mapping Agency)
BAPPEDA	*Badan Perencaanan Pembangunan Daerah* (Local Development Planning Agency)
BAPPENAS	*Badan Perencanaan Pembangunan Nasional* (National Development Planning Agency)
BPS	*Badan Pusat Statistik* (National Statistic Agency)
BPN	*Badan Pertanahan Nasional* (National Land Resources Agency)
BRPHP	*Bina Rencana Pemanfaatan Hutan Produksi* (Directorate of Planning and Production Forest Utilisation)
BBSDL	*Balai Besar Sumber Daya Lahan* (Land Resource Agency)
BKKBN	Badan Koordinasi Keluarga Berencana Nasional (National Coordinating Agency for Family Planning)
BPKH	*Balai Pemantapan Kawasan Hutan* (Forest Establishment Unit)
BPKM	*Badan Koordinasi Penanaman Modal* (Indonesia Investment Coordinating Board)
CIFOR	Centre for International Forestry Research
COP	Conference of Parties
DNPI	*Dewan Nasional Perubahan Iklim* (National Climate Change Board)
DIPSDH	*Direktorat Inventarisasi dan Pemetaan Sumber Daya Hutan* (Directorate of Forest Resources Inventory and Mapping)
ETM	Enhanced Thematic Mapper
FAO	Food and Agriculture Organisation

FSO	Forest Service Office
FSC	Forest Stewardship Council
FL	Forestry Law 41/1999
FBL	Fiscal Balancing Law
GDP	Growth Domestic Products
GNRHL	*Gerakan Nasional Rehabilitasi Hutan dan Lahan* (National Movement of Land and Forest Rehabilitation)
GoI	Government of Indonesia
GPS	Global Positioning System
HP	*Hutan Produksi* (Production Forest)
HPB	*Hutan Produksi Biasa* (Permanent Production Forest)
HL	*Hutan Lindung* (Protected Forest)
HSAW	*Hutan Suaka Alam and Margasatwa* (Conservation Forest)
HPT	*Hutan Produksi Terbatas* (Limited Production Forest)
HPK	*Hutan Produksi yang dapat Dikonversi* (Conversion Production Forest)
HTR	*Hutan Tanaman Rakyat* (Community-based plantation forest)
HDI	Human Development Index
HPI	Human Poverty Index
IFCA	Indonesia Forest Climate Alliance
IPCC	Intergovernmental Panel on Climate Change
ITTO	International Trade and Timber Organisation
JCP	Joint Certification Programme

LEI	*Lembaga Ekolabel Indonesia* (The Indonesian Eco-labelling Council)
MA	Marrakech Accords
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MoEMR	Ministry of Energy and Mineral Resources
MoDA	Ministry of Domestic Affairs
MoF	Ministry of Forestry
MoMT	Ministry of Manpower and Transmigration
MoSW	Ministry of Social Welfare
MFD	Minister of Forestry Decree
NPV	Net Present Value
OMOT	One Man One Tree
OBIT	One Billion Indonesian Tree
PPKH	*Pinjam Pakai Kawasan Hutan* (Forest Rent-Use Mechanism)
PERHUTANI	*Perusahaan Hutan Nasional Indonesia* (State Owned Forestry Company)
PHAPL	*Pengelolaan Hutan Alam Produksi Lestari* (Sustainable Natural Production Forests Management Certification Program)
PIPK	*Pusat Inventarisasi dan Perpetaan Kehutanan* (Centre of Mapping and Forest Inventory)
RAL	Regional Autonomy Law
REDD	Reduced Emissions from Deforestation and Forest Degradation
REDD+	Reduced Emissions from Deforestation and Forest Degradation (The

	'plus' sign includes forest conservation, sustainable forest management, and forest carbon stock enhancement)
RHL	Rehabilitasi Hutan Lindung (Rehabilitation of Protected Forests)
RLK	Rehabilitasi Lahan Kritis (Rehabilitation of Degraded Land)
REL	Reference Emission Level
SLC	Scan Line Corrector
SPOT	Système Pour l'Observation de la Terre (System for Earth Observation)
UKP4	*Unit Kerja Presiden Bidang Pengawasan dan Pengendalian Pembangunan* (Special Working Unit for Supervision and Controlling of National Development)
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund

Table of Contents

List of Tables

List of Figures

I. Introduction

This chapter provides an outline of the thesis and covers the background and research aims of the study. The current situation in Indonesia is described briefly, particularly issues on forest management, deforestation and forest degradation and the definition of deforestation and forest degradation employed in this study are also presented.

A. Background

Indonesia, the third largest tropical forest country with ± 131.3 million ha of terrestrial forests (MoF, 2008b), also has the second highest deforestation rate among tropical countries (FAO, 2010). Brazil is ranked first and Argentina third (Harris et al., 2012). Nearly 2 million ha of forest area are disappearing annually in Indonesia (Global Forest Watch, 2010). The rate peaked at 3.5 million ha per year between 1996 and 2001 (BAPPENAS, 2010). The 10% of tropical rainforests remaining in 1997 (Arunarwati, Hussin, & Weir, 1997) and the 5% in 2007 (Sugardiman, 2007) are in danger of being completely lost and contributing to global climate change. Between 2000 and 2005, Brazil and Indonesia contributed 55% of the global emissions rate from tropical deforestation (Harris et al., 2012).

Much research has been done to quantify and to understand the deforestation process in different regions in the world, but specific attention has been given to the tropics, where a high rate of deforestation occurs (FAO, 2005). Most of the research has found that agricultural practices are the most common reason for the forest loss in the tropics, especially in Indonesia (Angelsen, 1995; Barbier & Burgess, 2001; Dauvergne, 1994; Erasmi, Twele, Ardiansyah, Malik, & Kappas, 2004; Geist & Lambin, 2002; MoF, 2008c; Purnamasari, 2008; Sunderlin, Angelsen, Resosudarmo, & Dermawan, 2001; Verchot et al., 2010). Angelsen (1995) indicates that half of the tropical deforestation is caused by the expansion of agricultural practices, and Spray and Moran (2006) believe that rainforest has been converted to other land uses in order to meet agricultural production.

In Indonesia, between 1990 and 1996, the main causes of deforestation were agriculture, transmigration and the timber industry (Sunderlin & Resosudarmo, 1996). Between 1996 and 1999, illegal logging, mining expansion, poverty, global financial crises, and forest fires were believed to be the main causes (Contreras-Hermosilla, 2000; Sugardiman, 2007; Sunderlin, et al., 2001). Starting in 2001, most research showed that agricultural plantation expansion was the major cause of deforestation in Indonesia, and the latest research in 2010 and 2011 indicated that on top of the aforementioned causes, deforestation in Indonesia was also caused by plantation development, especially oil palm plantation and pulpwood production (Broich et al., 2011; Verchot, et al., 2010).

Deforestation is a complex process. Different actors are involved, different causes trigger the activities and different regions have different rates. In Indonesia, the direct and underlying causes of deforestation are clear and both cannot be excluded; however how much each of these causes contributes to deforestation is not well understood. Most of the quantitative studies of deforestation in Indonesia have specifically focused on quantifying the deforestation rate using different sources of satellite imagery and different remote sensing applications (Arunarwati, et al., 1997; Arunarwati & Weir, 1998; Broich, et al., 2011; Erasmi, et al., 2004; Hansen et al., 2009; Schoen, 2004; Sugardiman, 2007). Very few direct quantitative studies have been done to relate and quantify deforestation to particular direct and underlying causes (Gao, Skutsch, Masera, & Pacheco, 2011).

Forest degradation in Indonesia has also negatively affected the sustainability of the forestry sector in the country. However, fewer attempts have been made by the Government of Indonesia (GoI) to quantify forest degradation of the 131.3 million ha of forest estate of the country. Forest stock in Indonesia is decreasing by 6% per year and only one-third of this is caused by deforestation (Murdiyarso et al., 2008). In Indonesia, logging activities are believed to be the single largest contributor to forest degradation. Other contributors have never been quantified as monitoring forest degradation is a difficult task, even by remote sensing or by systematic forest inventory (Murdiyarso et al., 2008).

B. Research aims

The aims of this study are to quantify the deforestation and forest degradation rates and to quantify how much each of the selected variables contributes to deforestation and forest degradation in three provinces of Indonesia; East Kalimantan, South Kalimantan, and South East Sulawesi (SE Sulawesi). The variables selected for this research are a mixture of direct and underlying causes and include: (a) population density, (b) poverty rate, (c) mining activity, (d) agricultural activity, (e) crop plantation activity, (f) road network, (g) the degree of slope, (h) forest concessions, and (i) transmigration development. The study also attempts to examine deforestation and forest degradation between 2000 and 2009 within the designated official forest areas.

The specific questions to be addressed in this study are:

(1) Between 2000 and 2009, what are the rates of:
   a. Deforestation
   b. Forest degradation

(2) Whether the legal status of land has any effect on:
   a. Deforestation
   b. Forest degradation

(3) In the three provinces of the case studies, what variables explain the rate of:
   a. Deforestation
   b. Forest degradation

This research project was specifically designed to utilise a Geographic Information System (GIS) to analyse the spatial dependency of forest loss on the selected variables. Data collected from sub-districts level were aggregated into district level and then into provincial level to enable the research aims to be met. GIS also allows the generation of maps of deforestation and forest degradation of the three study sites.

C. Research definition

The term deforestation adopted in this study refers to the United Nations Framework Convention on Climate Change (UNFCCC) definition on deforestation as the direct, human induced conversion of forested land to non-forested land (FAO, 2003a), while the term forest degradation refers solely to the change of primary forests to secondary forests over the period of time. The changes are indicated by the land cover maps of Indonesia obtained from the Ministry of Forestry (MoF).

D. Structure of the Thesis

This thesis is structured as follows:

Chapter 1 has presented the general outline of this thesis.

Chapter 2 reviews relevant literature covering forest management in Indonesia, demographic change, deforestation and forest degradation in the country, land use change issues, as well as forestry related intervention programs that are initiated by the Government of Indonesia (GoI).

Chapter 3 explains the general research design and the methodology adopted to achieve the study objectives.

Chapter 4 describes the study sites where the study took place in three provinces; East Kalimantan, South Kalimantan and South-East Sulawesi. The geography, demography and particularly, land uses of these study sites are presented.

Chapter 5 presents the study results as the outputs of this study, including land use patterns and land use changes, deforestation and forest degradation rates, and maps of deforested and degraded areas of the study sites. How much each of the selected direct and underlying causes contribute to deforestation and forest degradation, and the relationship between deforestation and forest degradation, and independent variables will be presented in this chapter. The research results will also be discussed at the end of the chapter.

Chapter 6 draws the conclusions and provides the recommendations of this thesis.

II. Literature Review

A. Indonesia, the mega-diverse country

Indonesia, the largest archipelago country in the world, covers a total terrestrial area of 1,860,359 km^2 and spans 5,120 km across the equator, and has more than 17,000 islands (Bakosurtanal, 2012; BPS, 2000b, 2010). Only 8,172 of these islands have been registered and named by the Indonesian Government through the National Coordinating Agency for Survey and Mapping (*Badan Koordinasi Survei dan Pemetaan Nasional* - BAKOSURTANAL) (Bakosurtanal, 2012). The five biggest islands of Indonesia are Sumatera (Andalas), Kalimantan (Borneo), Sulawesi (Celebes), Java and Papua (the western part of New Guinea Island). Kalimantan is the third largest island in the world, and the whole New Guinea Island is the second largest after Greenland (MacKinnon, Hatta, Halim, & Magalik, 1996). The country is situated in the South East Asian region and shares boundaries with Malaysia, Papua New Guinea, and East Timor. East Timor (*Timor Timur*) used to be one of the provinces in Indonesia, but it gained independence through a referendum scheme back in 1999.

Indonesia is rich in biodiversity. In fact, this country has 80% of its area as part of a world biodiversity hot spot (see Figure I-1) (Myers, Mittermeier, Mittermeier, Fonseca, & Kent, 2000). Indonesia is biologically the world's most diverse country, and is located between the two major biogeographical regions of Australasia and Indo-Malaya (Baines & Hendro, 2006). The western parts of Indonesia; Sumatera, Java, Kalimantan, and Bali (collectively called the Sundaland) were part of the Asian Continent, while the eastern part; Papua, was part of the Australian Continent (Whitten, Mustafa, & Henderson, 1988). The Wallacea region is the transition region where Sulawesi, Moluccas, and the Lesser Sundas are located (see Figure II-1). These areas have never belonged to any continent (Whitten, et al., 1988).

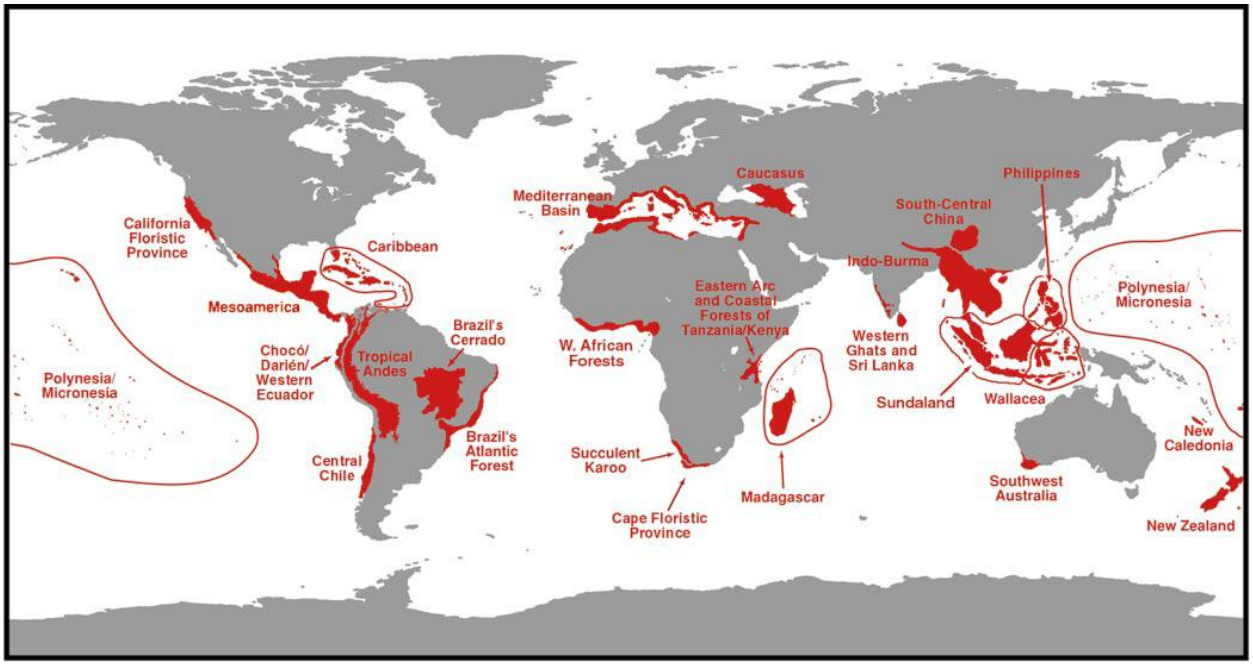


Figure II-1 The World's 25 Biodiversity Hotspots (Myers, et al., 2000)

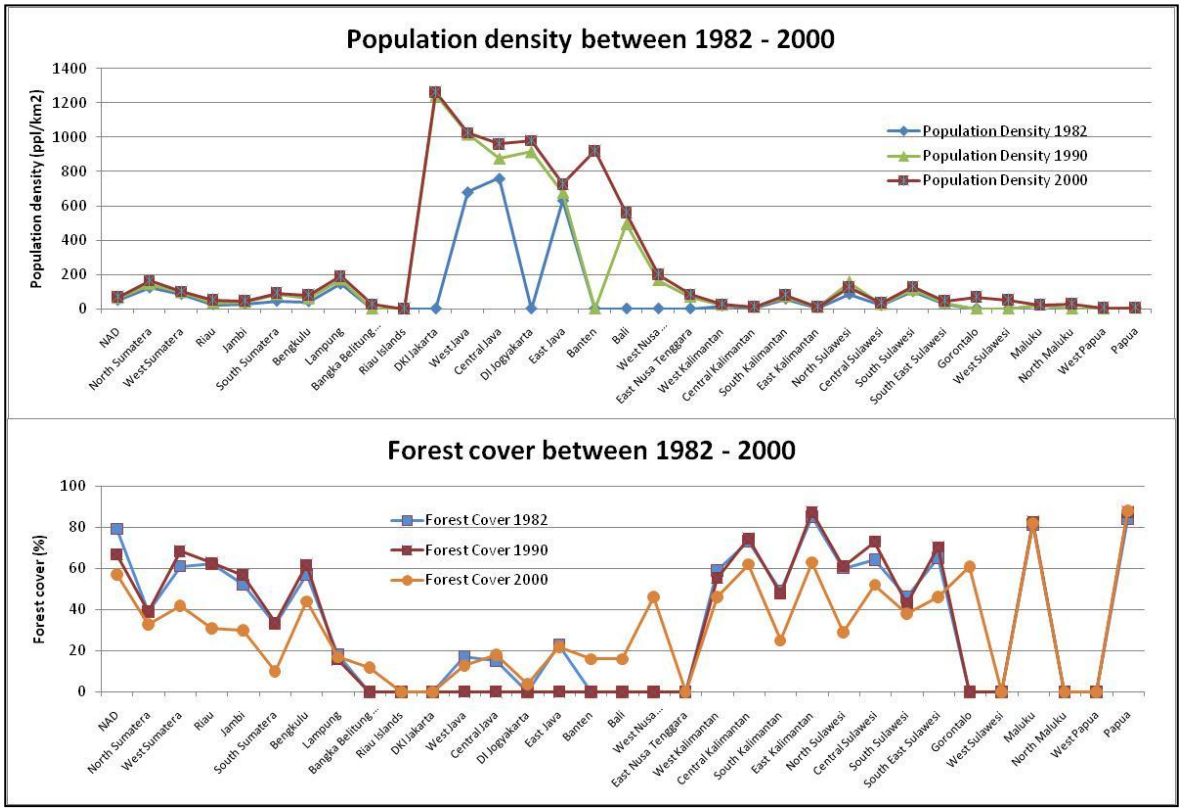
In terms of biodiversity richness, Indonesia has some 12% of the world's mammals (515 species, 39% endemic), 16% of its reptiles and amphibians (511 reptile species, 29% endemic, and 270 amphibian species, 40% endemic) and 17% of its birds (1531 species, 26% endemic) (Baines & Hendro, 2006; Mittermeier, Mittermeier, & Gil, 2004). Furthermore, this mega-diverse country is a host for 1,400 freshwater fish, 30,000 to 35,000 plant species and for the world's richest coral species biodiversity (Baines & Hendro, 2006; Mittermeier, et al., 2004). Species richness ratio per hectare is 12 endemic plants and 0.6 endemic vertebrates per hectare in the Sundaland biodiversity region (see Figure II-1), and 2.9 endemic plants and 1.0 endemic vertebrates per hectare in the Wallacea region (Myers, et al., 2000). Indonesia is one of the biologically wealthiest nations and the top ranked among the mega-diversity countries (Baines & Hendro, 2006; Mittermeier, et al., 2004; Myers, et al., 2000).This country is also a home for 300 ethnic groups and over 500 different traditional languages and dialects (Sabandar, 2004).

B. Demographic Change

Indonesia was home for 236 million inhabitants in 2010; the population density is 132 per square kilometre, compared to only 179 million in 1990, and 119 million in 1971 (BPS, 2012a). The population has grown significantly over the last three decades placing Indonesia among the top five most populous countries worldwide. Between 1971 and 1980, the population grew by 2.31% but reduced to 1.49% between 1990 and 2000 (BPS, 2012c). The New Order's regime that ruled the country for 30 years from 1966 to 1998, succeeded in controlling the population growth by introducing a family planning program, promoting a two children policy, and providing no subsidies for the third child.

Demographic composition in this country is not well distributed across the islands particularly between the western and eastern parts of the country and between rural and urban areas. The population is mostly concentrated in Western Indonesia, which includes Sumatera, Java, Bali, and Kalimantan, while the eastern part of the country includes Sulawesi, Lesser Sunda, Moluccas, and Papua. Since the 1970s, 80% of the country's population has been domiciled in Western Indonesia and the rest is distributed unevenly across Eastern Indonesia (BPS, 2012a). Java Island is the most populated area; 60% of Indonesians live in this island, although the area covers only 7% of the total country area (BPS, 2012a). In contrast, while Sulawesi, Kalimantan and Papua cover 10%, 28%, and 22% of total land area, these areas are only inhabited by 83, 45, and 7 people per square kilometre respectively (BPS, 2012a) compared to Java with 1,062 people per square kilometre. In Jakarta, the capital of Indonesia located in Java Island, the population density is 14,440 people per square kilometre (BPS, 2012a). This population disparity is associated with the natural resources and the development priorities set by the government. In the past, during the Dutch colonisation, the national economic infrastructure was built and concentrated in Western Indonesia, particularly in Java. For instance, train networks are only available on the island of Java and Sumatera. The geographical condition of Eastern Indonesia, which is mountainous and densely forested, imposes a high cost on development and this situation has been used to justify the development priority in Western Indonesia (Sabandar, 2004). However, this was also the main reason for forest cover being lost in the

over-populated areas such as in Java. Figure II-2 draws the relationship between population density and forest cover in Indonesia between 1982 and 2000.



Source: BPS, 2010, 2012a; MoF 2011b; and updated from Frazer (1996) as cited in Sunderlin & Resosudarmo, 1996

Figure II-2 Population density and forest cover between 1982 and 2000

As can be seen from Figure II-2, provinces in Java have a high population density but low forest cover, while provinces in Eastern Indonesia such as Papua have a low population density and high forest cover. A high population density is associated with a low forest cover. For every 1% of population growth, forests are lost at a rate of approximately 0.15% - 0.40% (Fraser, 1996 as cited in Sunderlin & Resosudarmo, 1996, 1999). Fraser (1996) also suggests that population density is the main reason for the high rate of deforestation in Indonesia. A high population pressure on Java Island contributed indirectly to the loss of forest areas in the outer islands (Sumatera, Kalimantan, Sulawesi and Papua) of Indonesia (Sunderlin & Resosudarmo, 1999). This was due to the fact that forest areas of the outer

islands were cleared to support government-sponsored relocation programs for establishing settlement areas for people from Java Island (Sunderlin & Resosudarmo, 1999).

C. Forest management in Indonesia

1. Forest establishment process

In Indonesia, the definition of forest has two meanings; forest as the legal status of land (forest estate) and forest as the land cover of a land (forested or non-forested areas). The official definition of forest by the Indonesian government has little relation to the ecological term of forest in general (Barber, 2002). MoF assigned forest areas based on their functions and this is formally enacted through the Ministerial Decree. The designated forest areas can be fully covered forested land or non-forested land. Inadequate funds, a lengthy process and the vast amount of forest areas that need to be processed have delayed the final and formal establishment of forest areas in Indonesia.

There are three stages of the forest establishment process:

- Forest area designated
- Forest area boundary demarcation activities
- Forest area establishment

By 2000, MoF had designated forest areas in all the 31 provinces of Indonesia apart from Riau and Central Kalimantan. Forest areas were assigned in the area of Central Kalimantan Province in 2011, but in Riau they have not been designated formally because land use and land title problems in this province are more complicated compared to other provinces of Indonesia. Based on the MoF Ministerial Decree, total Indonesian terrestrial forest areas are 131,3 million ha or 136,2 million ha including marine reserved areas (MoF, 2011b).

Although MoF has assigned the legal forest estate, few of these areas have been demarcated with signs place on the ground to locate forests and non-forest areas. Therefore, very few of the designated forest areas have been established legally as forest

estate. Based on the Minister of Forestry Decree 47/2010, a working group representing various institutions such as MoF, the Forest Service Office at provincial and district levels (*Kantor Dinas Kehutanan Provinsi/Kabupaten*), the National Land Agency Office at provincial/district level (*Badan Pertanahan Kabupaten/Kota*), the provincial/district Planning and Development Agency (*Badan Perencanaan and Pembangunan Daerah Kabupaten/Kota – Bappeda*) should set up boundaries and place signs on the ground, establish a new map of forest estate areas based on demarcation activities, provide a recommendation and, most importantly, clean and clear all the land use and land title problems on the ground in relation to the designation of forest estate. The process takes time and there is a high cost associated with finishing the task. Based on the working group recommendations, the Minister of Forestry enacts a final official and legal decree to establish forest estate partially for each of the provinces. By 2005, only 11% of the total assigned forest areas had been established legally by MoF (Contreras-Hermosilla, 2005 as cited in Noorwijk, 2007). Furthermore, no forest estate was established in the years 2007 and 2008, only 113,654 ha in 2009, and another 847,148 ha in 2010 (MoF, 2011b).

The Forestry Law 41/1999 and its predecessor the Forestry Law 5/1967 apply to all activities conducted in the official forest areas in all three stages aforementioned. Lack of signs on the ground and delay in establishing forest estate into a legal status have promoted illegal activities and encroachment on forest areas in all provinces of Indonesia. Locals and even officers are not aware of the boundaries of forests and non-forests unless they are well-equipped with a valid map or with an advanced technology tool like a global positioning system (GPS). Problems also arise because forest encroachment is perceived differently by the Government and local people. The government claims and assigns land as forest estate, while locals have been living in the same areas for many years and even long before it was established as a forest estate by the government. Forest area designation has created social conflicts, in which 52% of these assigned forest areas coincide with the claims of local people to rights on their customary lands (Noordwijk et al., 2007). These persistent land title conflicts contribute to the deforestation in Indonesia (Noordwijk et al., 2007).

2. Forest areas based on their function

MoF classifies the total 136 million ha of the country forests based on their function. This is designated particularly to manage the forest resources in a sustainable manner without undermining its potential to support the economy of Indonesia. Ideally all natural resource extraction activities should be carried out in the allocated forest areas based on their function, with legal and compulsory requirements applied. However, this ideal condition has never been achieved in Indonesia.

The Forestry Law 5/1967 was repealed and replaced by the new Forestry Law 41/1999. The law classifies Indonesian forest areas based on their main functions: Production Forests (*Hutan Produksi - HP*), Protection Forests (*Hutan Lindung - HL*) and Conservation Forests (*Hutan Suaka Alam dan Pelestarian Alam - HSAW*) . Figure II-3 shows the Indonesian forest areas.

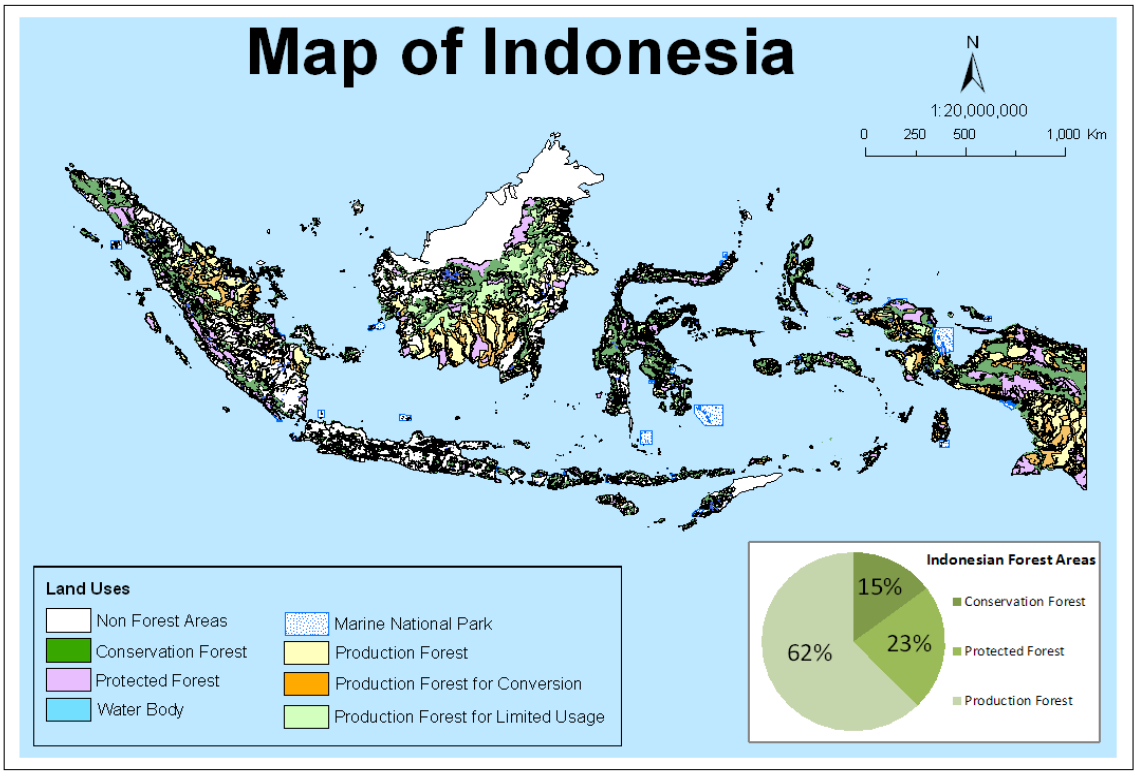


Figure II-3 Indonesian forest areas

Production Forests (HP), 61.29% of the total, are the areas for extracting timber and other non-timber products. Protected Forests (HL), 23.81% of the total, are the areas for maintaining hydrological functions, and Conservation Forests (HSAW), 14.90% of the total, are the areas for conserving biodiversity, protecting ecological balances and carrying out nature-based tourism activities. Table II-1 shows the total forest areas of Indonesia.

Table II-1 Forest areas of Indonesia

Forest Areas based on its Function	Areas (Ha)	Terrestrial Forest Areas (Ha)	Total Forest Areas (Ha)
Protected Forests	32,211,814.72	32,211,814.72	32,211,814.72
Conservation Forests – Marine reserved areas	4,894,732.00	21,232,007.27	26,126,739.27
Conservation Forests – Land reserved areas	21,232,007.27		
Permanent Production Forests	34,142,045.73	77,835,529.99	77,835,529.99
Limited Production Forests	22,818,159.26		
Conversion Production Forests	20,875,089.00		
T O T A L (Ha)		131,279,352.98	136,174,084.98

Source : Ministry of Forestry (MoF, 2008b)

Production forests (HP) are divided into three main categories:

- Limited Production Forests (*Hutan Produksi Terbatas - HPT*) accounting for 22.5 million ha.
- Permanent Production Forest (*Hutan Produksi Biasa - HPB*) accounting for 36.6 million ha.
- Conversion Production Forests (*Hutan Produksi yang Dapat Dikonversi – HPK*) accounting for 22.7 million ha.

Permanent production forest (HPB) status is assigned to all timber extraction schemes such as natural concessions, industrial plantations, community-based plantations and restoration ecology sites. Restoration ecology concession holders can extract the timber only when the ecological balance of the concession areas is achieved. The licence holder is permitted to extract non-timber products while facilitating the ecological restoration work. Limited production forests (HPT) are the transition areas between regular production forests (HPB) and protection forests (HL). HPT was initially not designed for industrial plantations.

However, due to economic pressures and the potential of the land, in 2006 MoF started to allow industrial plantation companies to extract timber from HPT (MoF, 2006).

Conversion production forests (HPK) were first introduced in the late 1980s. The area was especially assigned to the degraded forest areas (logged over areas) to be converted to non-forestry uses. HPK can be converted permanently into 'other land uses' including settlement, agriculture and crop plantations. These areas will later be removed from forest management. Mining and silvopasture[1] are not part of these 'other land uses' and forest estates that are used for mining and silvopasture preserve their status as forest. No scheme is available to convert the areas into non-forest areas under these uses. Mining operations are granted under the rent-use mechanism (*Pinjam Pakai Kawasan Hutan – PPKH*), while silvopasture is assigned under utilization permits for individual and commercial uses without changing the forests' status (*Izin Usaha Pemanfaatan Kawasan Silvo Pastura – IUPK-SP*). Mining operations can take place in HPB, HPT and HPK (open pit mining and closed pit mining) and HL (restricted to closed pit mining only), while silvopasture is also allowed within HPB, HPT and HPK (MoF, 2009b).

3. Forestry activities

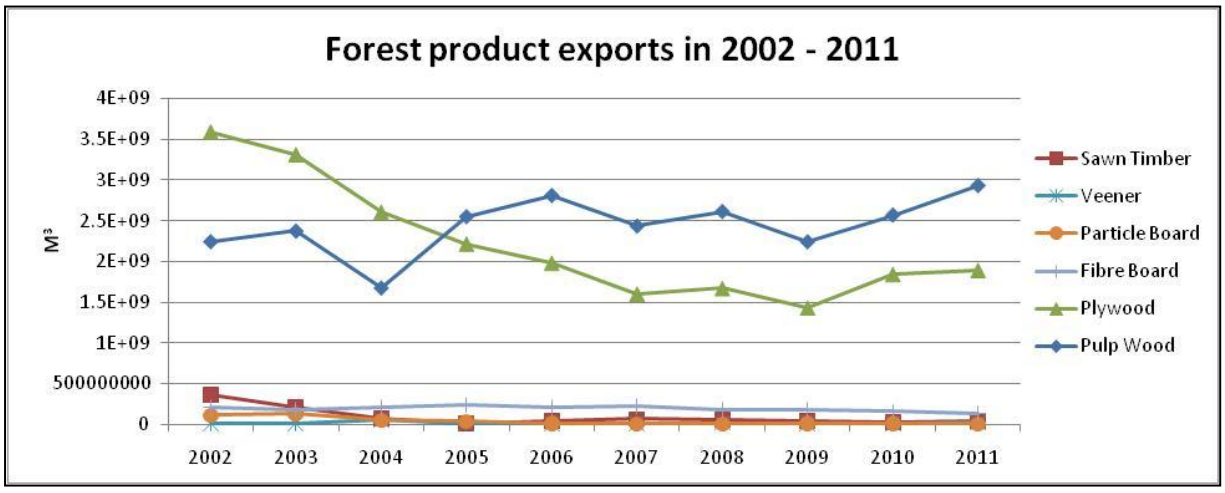
Forestry is one of the most important sectors in the Indonesian economy. Since the country gained independence in 1945 and struggled to alleviate poverty between 1945 and 1966, Indonesian forest areas have been managed in such a way as to contribute to the national revenue. Indeed, forestry is second after oil and gas as the top national revenue contributor (Barr, 2001).

Numerous legal instruments were introduced by the former Indonesian president, Suharto, such as the Foreign Investment Law 1/1967, the Forestry Law 5/1967, the Mining Law

[1]Silvopasture is an activity that combines forestry and grazing of animals. In Indonesia, based on the Minister of Forestry Decree 63/2009, silvopasture is defined as a forestry activity that is proportionally combined with grazing of animals within production forests (HP). The activity includes cattle ranching for forage and livestock production in line with sustainable forestry management.

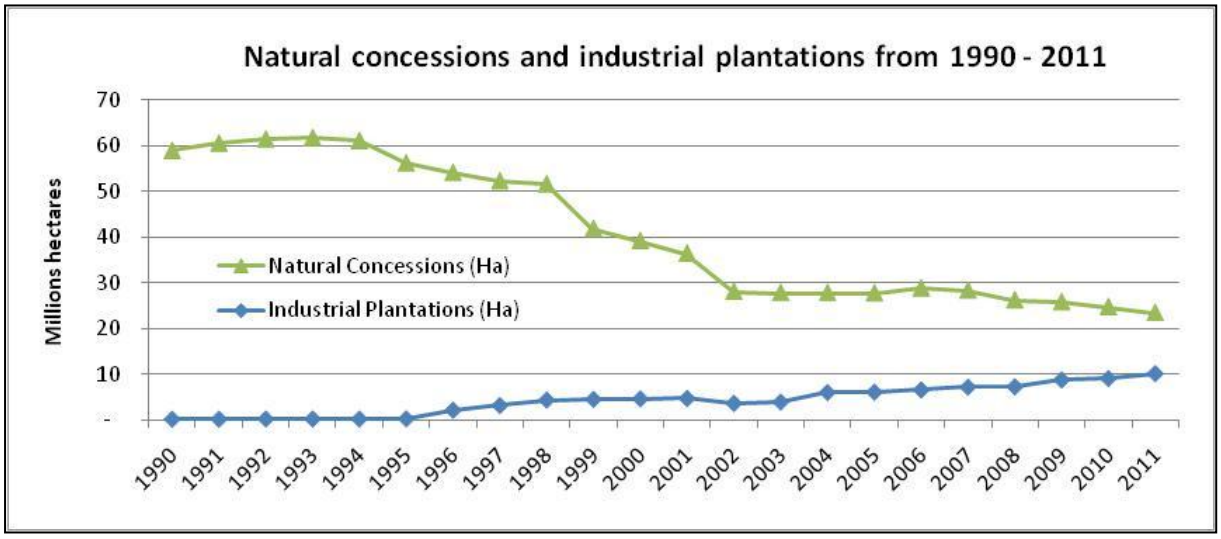
11/1967, and the Domestic Investment Law 6/1968 to attract investors to extract the country's natural resources, including valuable timber species from the tropical rainforest of Indonesia. Figure II-4 presents total exports from the forestry sector including sawn timber, plywood, veener, pulp wood, particle board, and fibreboard between 2002 and 2011, and Figure II-5 presents the areas of natural concessions and industrial plantations in Indonesia.

Between 1990 and 2011, Japan, China and Korea are the three largest importers of most Indonesian forest products, especially plywood and veneer to Japan,and sawn timber and pulp to China (MoF, 2008b, 2011b). The figure does not reflect the legality of timber resouces (see Figure I-4). Although illegal logging in Indonesia is very rampant (Barr, 2001; Casson & Obidzinski, 2002; Ismail, 2007), it is difficult to quantify the real production output from illegal logging because vague official statistics conceal the real figure (Casson & Obidzinski, 2002). For instance, in 1999 alone, there was a 32 million m^3 discrepancy between the total official log production and output from wood-processing industries (Casson & Obidzinski, 2002).



Source: Ministry of Forestry (MoF, 2011b)

Figure II-4 Forest product exports in 2002 - 2011



Source: Minstry of Forestry (MoF, 2000, 2011b)

Figure II-5 The areas of natural concessions and industrial plantations from 1990 - 2011

Figure II-5 depicts the downward trend of the natural concession areas, while the reverse trend was true for the industrial plantation forests. The trends correspond with the downward trends for plywood and sawn timber production and upward trend for pulp wood production (see Figure II-4).

By mid 2011, about 36.8 million ha of production forest areas have been utilised largely for forestry-based activities (see Table II-2) (MoF, 2009a). The majority of production forests have been allocated for natural concessions; 23.6 million ha in 2009 and 22.7 million by mid 2011 (MoF, 2009a, 2011a). Table II-2 shows existing and potential forestry development within production forest areas.

Table II-2 Existing and potential forestry development[2]

Type of Forest Usage	Forests utilisation		Potential long-term allocation
	2009	**Mid 2011**	
Natural Concessions	23,646,787.00	22,710,256.00	13,228,555.00
Industrial plantations	8,619,928.00	9,677,935.00	10,555,573.00
Restoration ecology sites	53,657.00	185,005.00	4,418,442.00
Community-based plantations	-	126,294.95	7,167,278.00
Environmental services	-	-	16,013.00
Conservation sites	-	-	896,568.00
Non-timber activities	-	21,620.00	2,230,674.00
Non-allocation areas to avoid legal problems (not allocated for forestry activities due to encroachment, land conversion etc).	-	-	5,824,003.00
Forest activities in the other utilization – non forest areas (*Areal Penggunaan Lain - APL*)	2,037,203.00	2,037,203.00	-
T o t a l	**34,357,575.00**	**36,795,516.95**	**44,337,106.00**

Source: Ministry of Forestry, (MoF, 2009a, 2011a)

In 2009, MoF designated the potential utilization of 44.3 million ha of production forest areas in 26 provinces for forestry activities development. These areas were assigned for forestry-based activities based on the land characteristics including forest cover, forest functions, the degree of slope and land systems. The proposed areas were designed for natural concessions (13 million ha), industrial and community-based plantations (17 million ha), and restoration ecology sites (4 million ha) in 26 provinces (see Table II-2) . There are seven provinces excluded from this proposed potential utilisation namely all six provinces in Java Island (Banten, DKI Jakarta, West Java, Central Java, Jogyakarta, and East Java) and Bali. The latter is excluded because this province has no significant forest areas, while other provinces in Java Island are excluded because most of the forest areas in Java are managed under the state-owned company PT. PERHUTANI. The working areas of PT. PERHUTANI

[2]Total production forests (HP) account for 77.8 million ha (see Table II-1). By March 2009, about 32.3 million ha of these areas have been used for forestry activities (2 million ha of non forest areas were not included) and around 44 million ha of production forests (HP) are available for forestry investors (see Table II-2).

cover a total of 2.4 million ha of forest areas in Java Provinces such as Banten, West Java, Central Java and East Java (MoF, 2004; PERHUTANI, 2011).

Different types of forestry-based activities proposed by MoF in 2009, such as natural concessions, industrial plantation, restoration ecology sites, commiunity-based plantations are designed to meet the existing condition of the forest areas in order to use the resources to the fullest. For instance, primary forests are allocated for natural concessions, secondary and degraded forests are allocated for industrial and community-based plantations, while forests with high conservation value are designated for restoration ecology sites or conservation sites, where mining operations are banned within the sites. The forest areas with a high risk of social conflicts are excluded from this proposal. The areas need to be cleared from any land use and land tenure problems before making them available to the potential forestry investors. MoF is, however, inconsistent in implementing this proposal. Huge primary forests of Papua were allocated to some investors to establish industrial plantation forests, and in Sumatera, mining companies were allocated areas overlapping a restoration ecology site, a departure from the initial proposal.

4. Monitoring and evaluation of existing forest concessions

In response to international demand for sustainable forestry products; MoF, the Indonesia Eco-labeling Council (*Lembaga Ekolabel Indonesia – LEI*), and the Indonesian Association for Forest Concessions Holders (*Asosiasi Pengusaha Hutan Indonesia – APHI*) have initiated certification programs designed to meet the requirements especially of European and American markets (MoF, 2009c).

All of the organisations or agencies which have the capability to certify a forest concession should have a certain credibility that is recognised internationally. LEI introduced a Voluntary Certification Program and has a memorandum of understanding (MoU) with the Forest Stewardship Council (FSC) setting up a Joint Certification Program (JCP). On the other hand, MoF carried out a mandatory certification initiative; Sustainable Natural Forests Management Certification Program (*Pengelolaan Hutan Alam Produksi Lestari – PHAPL*) for

all of the commercial forest concession companies. This is designed to meet the international standards and to obtain a 3% to 5% premium price for the timber products of Indonesia. As for APHI, the association initiated a Self Declare Certification as a control mechanism for its members to meet sustainable forest management. The mechanism is also designed to motivate its members to comply with PHAPL.

MoF as a regulator, facilitator and stewards of the official forest areas, designed PHAPL to monitor and evaluate forest concession holders' compliance with government regulations and policies. PHAPL aims to achieve sustainable forestry products and sustainable forest management of Indonesia. The scheme includes pre-existing conditions, production, ecology and social indicators, and the certificate is classified into three categories: good, moderate, and worst (MoF, 2009c)

PHAPL is a mandatory scheme and the level of adoption among forest concession holders is quite high (64%) but most of the companies are certified as moderate. Only 23% of the companies are good and comply with the PHAPL requirements (MoF, 2009c). In Kalimantan where a high number of forest concessions are operating, 61% of companies did not pass the certification process and hold a 'worst' category. Only 11% of the companies received a 'good' category (Greenomics, 2013).

Unsustainable practices by forest concession holders in Indonesia appear to be one reason explaining forest decline, deforestation and forest degradation in the country. Sunderlin & Resosudarmo (1996) explained why some concessionaires in Indonesia are unsustainable in exploiting forest resources. They believed that:

- The Government of Indonesia (GoI) allocates too much land for concession holders, thus creating little incentive for the licence holders to safeguard the concession areas from encroachment, or even to stop such encroachment.
- Low fees and high export taxes limit the domestic price of timber. Therefore, there is no intention by the licence holders to adopt sustainable forest management
- As the provincial government receives a small share of timber concession fees, replacing forest by other land uses is preferable.

5. National institutions and policy making

National policies in relation to power sharing between central and local governments and policies in relation to natural resource management in Indonesia seem to be ineffective and inefficient in supporting sustainable use of natural resources, especially forest resources.

Under the new Regional Autonomy Law (RAL) 22/1999 and its latest version 32/2004, there are two levels of administration; central and local government. Central government includes all ministries and national agencies, and local government includes the provincial and district levels. This law supports a less top down approach in the relationship between central and local government and a more coordinative line. It provides exclusive rights to the central government to rule national security, foreign affairs and policy, justice, monetary and fiscal policy, while local governments have the right to manage and to rule all other aspects. The RAL and the Fiscal Balancing Law 25/1999 (FBL) introduced in 1999 give limited control to local government to self-manage the financial aspects, and give full power to central government to control and manage the national monetary system (Colfer & Resosudarmo, 2002). However, it is suspected that RAL and FBL were designed to give opportunities to local government officials to financially benefit from RAL and FBL (Colfer & Resosudarmo, 2002). There is now less tension between central and local government disputing control over forest resources (McCarthy, 2000). These laws in fact provide a wide opportunity for corrupt practices in government institutions at all levels.

Booth (2003), as cited in Sabandar (2004), supports Indonesia in its changing of the centralised administration towards decentralised in 1999/2000. It is arguable that RAL and FBL support an efficient and effective governance system for Indonesia. Before RAL was implemented in 1999/2000, Indonesia consisted of 27 provinces (BPS, 2000a). RAL allows provinces, districts and sub-districts to proliferate and establish new administrative bodies and by 2010 Indonesia was sub-divided into 33 provinces, 507 districts, and over 10,000 sub-districts (Ministry of Domestic Affairs, 2012). In the ten years between 1999 and 2010, at least 20 new administrative areas (at a minimum of district level) were established yearly due to the implementation of RAL (Harmantyo, 2011). Indeed, in 2012 a new province

called North Kalimantan was established. This new province was part of East Kalimantan in 2011 (Ministry of Domestic Affairs, 2012).

The new administrative bodies require more financial support from the government and are putting more pressure on the national budget (Harmantyo, 2011), as well as on the natural resources. The creation of new administrative areas utilises more natural resources, requires more land to build settlements, new governmental offices, new public amenities and public infrastructure. This means the implementation of RAL and FBL indirectly have put more pressure on natural resources and in particular have threatened the existence of forest resources.

Ineffective and inefficient policy making in Indonesia is also reflected in natural resource management. Natural resources are managed under different institutions and overlapping management does exist. Most of the policies are an institution-based approach rather than a holistic approach. Problems related to the use of natural resources are more or less due to the overlapping jurisdiction among central government institution as well as overlapping policies between central and local governments. Table II-3 indicates national institutions that are related to or overlap with forestry management in Indonesia.

Table II-3 National institutions related to forest management

National Institution	Related to forest management or overlap with the Ministry of Forestry
Ministry of Forestry (MoF)	Responsible for managing all forest estate areas, including providing a permit for mining and silvopasture, and approving forest conversions for agriculture, crop plantation, settlement, road networks and other public facilities.
Ministry of Agriculture (MoA)	Responsible for supporting development of crop plantation and food crops, and other tasks related to national food security programs. Crop plantation and food crops development can take place in conversion production forests (HPK).
Ministry of Environment (MoE)	MoE is the national coordinator for climate change and is responsible for

	improving environmental quality and preventing and controlling environmental pollution, including in forest estate areas
Ministry of Energy and Mineral Resources (MoEMR)	Responsible for supporting national energy policies and mineral resources management. Mining, oil and gas operations can take place in production forests (HP) and protection forests (HL).
Ministry of Manpower and Transmigration (MoMT)	Responsible for supporting manpower capacity development and facilitating transmigration programs, including developing a new settlement area within forest estate areas
National Planning Agency (*Badan Perencanaan Pembangunan Nasional - BAPPENAS*)	Responsible for coordinating, synchronising, and evaluating national development, including in forestry and water conservation activities
National Land Resources Agency (*Badan Pertanahan Nasional - BPN*)	Forest conversion to other land uses needs a certificate of rights to cultivate state land from BPN (*HakGuna Usaha – HGU*). All claims of forest areas from locals should be supported by any form of certificates issued by BPN, including a certificate from the Dutch colonisation period to prove the land title over forest areas.
National Coordinating for Surveying and Mapping Agency (Badan Koordinasi Survey dan Pemetaan Nasional - BAKOSURTANAL)	Responsible for coordinating national surveys and mapping strategy, including providing forestry thematic maps
A Special Working Unit for Supervision and Controlling of National Development (Unit Kerja Presiden Bidang Pengawasan dan Pengendalian Pembangunan – UKP4)	Responsible for monitoring and controlling over all ministries' performance (including MoF) in spending the national budget, and coordinating climate change initiatives and sustainable development programs

Table II-3 indicates how central government in Indonesia is overlapping in managing the natural resources of the country particularly in relation to forest management. For example

a major role of the Ministry of Agriculture (MoA) is national food security and the establishment of food crops and crop plantation (MoA, 2012). The Government of Indonesia (GoI) demarcates jurisdiction boundaries between forestry and non-forestry areas to differentiate the legal jurisdiction areas between MoF and MoA. MoF is responsible for managing forest estate, while MoA is responsible for managing all non-forest estate areas, especially in establishing crop plantation and food crops. Although MoA is responsible for managing crop plantation development, a legal permit from MoF is still needed if the area of development falls under the jurisdiction of MoF. Furthermore, regarding mining operations, although the Ministry of Energy and Mineral Resources (MoEMR) is responsible for giving a mining licence to a company, final and legal permits are also needed from MoF if the mining concessions are located within forest estate, and from local governments if the concessions are located in 'other land uses' areas (*Areal Penggunaan Lain – APL*). MoF is responsible for providing legal access to forest areas, while local government is responsible for providing a permit of APL utilisation.

The unsustainable forest management in Indonesia is also associated with the lack of coordination between central and local governments which also creates overlapping or non-synchronised policies. For instance, in 2007, in order to meet the timber supply for the national industry, to create employment, and to include local people's participation in forest management, MoF designed a new program called community-based plantation (*Hutan Tanaman Rakyat – HTR*) (MoF, 2007). The Minister of Forestry Decree (MFD) 23/2007 was repealed and changed to MFD 55/2011 which promulgated the mechanism of application for community-based plantations. The Decree Article 20 (6) states that MoF will provide and support the extension program for the first three years of the early stage of HTR, and local government will continue to provide such assistance after the first three year period. However, local government in provinces and districts has not synchronised this policy into their local regulations, as is happening for instance in Jambi, North Sumatera and many other provinces in Sumatera (Syamsiatun, 2011).

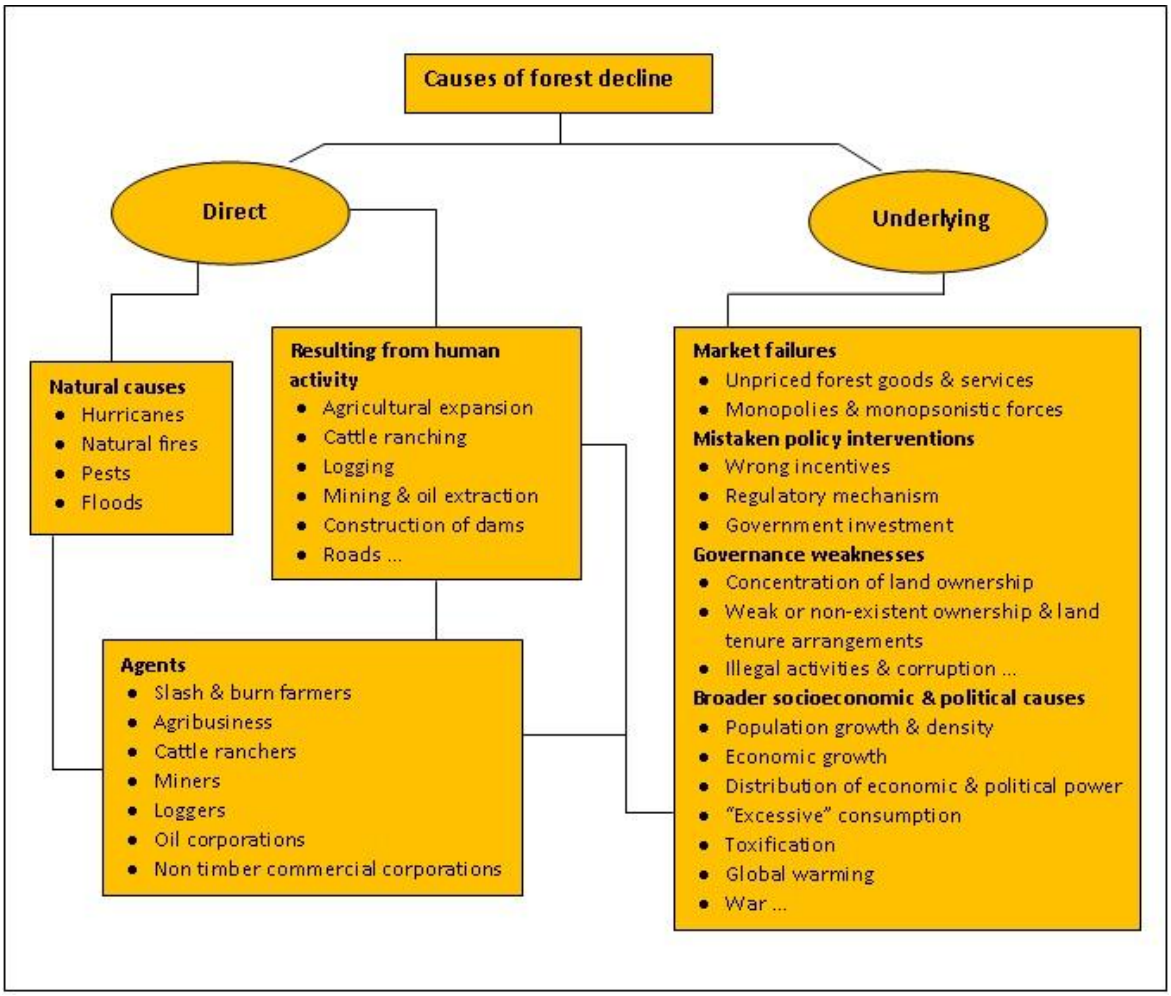
D. Deforestation and forest degradation in Indonesia

1. Deforestation

In defining deforestation, most organisations have a consensus about what constitutes deforestation. In 2001 FAO defined deforestation as “the conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10 percent threshold” and “deforestation implies the long-term or permanent loss of forest cover and implies transformation into another land use. Such a loss can only be caused and maintained by a continued human-induced or natural perturbation” (FAO, 2003a)

The most common definition adopted for deforestation was initiated through the United Nations Framework Convention on Climate Change in 2001. Deforestation was defined as the direct human-induced conversion of forested land to non-forested land. These definitions are widely adopted and agreed by most institutions, international organisations and governmental bodies. GoI has adopted the FAO definition on deforestation (BAPPENAS, 2010).

Contreras-Hermosilla (2000) suggested that the causes of forest decline include direct causes and underlying causes and believed that interaction between direct causes, underlying causes, and agents does exist. Figure II-6 shows the causes of forest decline.



Source: Contreras-Hermosilla, 2000

Figure II-6 The causes of forest decline

Figure II-6 presents the interactions between agents, direct causes and underlying causes. Agents are responsible for forest decline. Direct causes are when the agent clears the forests and converts it to other land uses in order to get commercial profits, or for subsistence reasons. Underlying causes are far more complex when compared to direct causes and are closely related to the way human societies organise (Contreras-Hermosilla, 2000). Agents include individuals, groups of individuals and institutions that convert forested land to other land uses, or cause forest degradation. Among these agents, most deforestation and degradation worldwide are blamed on loggers, followed by miners and oil operators. Other critical agents are farmers and agribusiness who convert forested lands to agricultural lands (Contreras-Hermosilla, 2000).

Mistaken policy intervention is one of the underlying causes of deforestation that appears to be an important factor in explaining deforestation in Indonesia. Government policy intends to achieve sustainability, but more often unintended results occur. Repetto (1993) as cited in Contreras-Hermosilla (2000) states that "Governments, many of which are committed in principle to conservation and wise resource use, are aggravating the loss of the forest under their stewarship through mistaken policies. Such policies, by and large, were adopted for worthy objectives: industrial or agricultural growth, regional development, job creation, or poverty alleviation. But such objectives typically have not been realised or have been attained only at excessive cost". Table II-4 presents policy intervention that contributes to deforestation.

Table II-4 Examples of policy failures that may lead to forest decline

Policies intervention	Activities
Direct government investment in the forest sector or in related sectors	• Road construction • Hydropower investments
Government command and control regulations	• Conservation area protection • Obligation to replant harvested areas • Prohibition on harvesting without a permit • Obligation to prepare forest management plans as a condition for intervening in forest areas • Log export bans
Fiscal, price or monetary policies	• Subsidies affecting forest raw materials or other inputs • Subsidies affecting competitive uses of lands, such as silvopasture • Plantation subsidies • Price controls • Subsidies affecting forest harvesting or manufacturing • Forest products taxes • Subsidised credit • Foreign exchange policies affecting competitive uses of lands
Provision of services	• Delimitation, demarcation and land titling • Actions to promote exports • Settlement of frontier areas

Source: Contreras-Hermosilla, 2000

For instance, policies to support and allow the establishment of road networks near or through forests, lead to deforestation and forest degradation. Although roads are built to support economic development, such as providing better access to timber resources,

promoting agriculture activities, and improving better access for remote villages to the capital, the policies have a negative ecological impact on the existence of forest areas. By each kilometre of new road built into forests, between 400 and 2000 hectares of forests alongside the road may be deforested (Contreras-Hermosilla, 2000). In another example, in 2006 MoF allowed industrial plantation to be established in limited production forests (HPT) (MoF, 2006). Although the Decree emphasised that only degraded areas in HPT can be converted into industrial plantations, large amounts of primary forests are included in industrial plantation areas . This government policy has led to some loss of forest stocks in primary forests and replacement by fast growing species for industrial plantations.

In Indonesia, MoF has assigned forest areas based on their function and has accommodated all other sectors such as agriculture, mining and transmigration to operate within the forest areas. The rates of deforestation and forest degradation however, are still high and forest resources are being lost at an alarming rate. Between 2000 and 2005, Indonesian forest areas equivalent to the size of 300 soccer fields were lost hourly (Indonesian Rainforest Foundation, 2012) making this country among the top three in the world for deforestation. Indeed, deforestation and forest degradation are pervasive problems in the country.

The deforestation rate in Indonesia reached 3.5 million ha per year within the period of 1997 and 2000 (MoF, 2008c). In 2008, The MoF claimed that between 2003 and 2006 Indonesian total forest areas decreased by 1.17 million ha. Indeed, between 2000 and 2005, the rate of the forest loss was 1.9 million ha per year (FAO, 2005). This figure was reported by the Ministry of Forestry to FAO in 2005 (MoF, 2008c). Surprisingly, in 2008, for the same period, 2000 to 2005, the Ministry of Forestry estimated the rate was 3.5 million ha/year (MoF, 2008c), while Hansen et al. (2009) indicated that the rate of deforestation in Indonesia during this period reached 0.71 million ha/year. The differences in estimating the rate could be caused by the technical method applied and different sources of satellite data employed. The definition of forest and deforestation, the remote sensing method applied and proper pre-processing of images play an important role in determining deforestation rate (Tucker, Steininger, & Slayback, 2001). Table II-5 indicates research that has been done

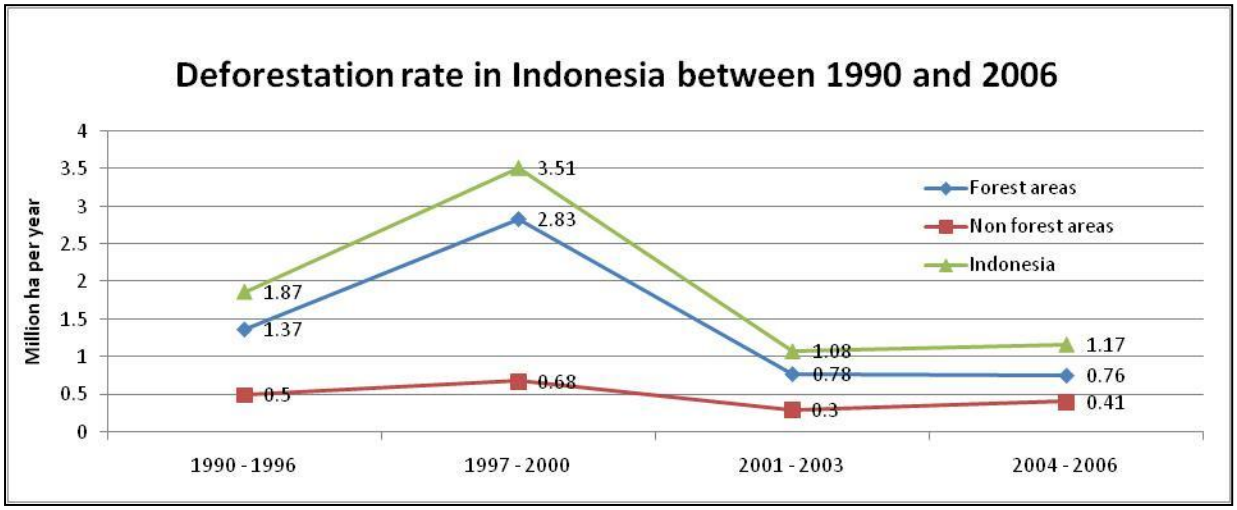
trying to quantify deforestation in Indonesia using different techniques and different sources of satellite data.

Table II-5 Research on quantifying deforestation rates in Indonesia

Source	Year	Data	Study Site(s)
Shaker S. R	1995	Optical	Bengkulu, Sumatera
Arunarwati	1997	Radar	Jambi, Sumatera
Zuhair	1998	Optical & Radar	Samarinda, East Kalimantan
Arunarwati, Hussin & Weir	1999	Radar	Central Sumatera
Hussin	-	Optical & Radar 1993 - 1994	Jambi, Sumatera
Erasmi et al.	2004	Optical 1972 – 1999 - 2002	Central Sulawesi
Schoen	2004	Optical 1992 - 2001	South Sumatera
Sugardiman	2007	Radar	Balikpapan, East Kalimantan
The Ministry of Forestry (IFCA Report)	2008	Optical 2000 - 2005	Indonesia
Hansen et al.	2009	Optical 1990 - 2005	Indonesia (mainly focusing on Sumatera & Kalimantan)
Hammer, Kraft & Wheeler	2009	Optical 2006 - 2008	Riau, Sumatera
Broich et al.	2011	Optical 2000 - 2005	Sumatera & Kalimantan

In 2000 and 2005, FAO released The Global Forest Resources Assessment (FAO, 2000, 2005).The report shows that for the period 1980 to 1990, 15.4 million ha per year of the world's forests were lost and degraded, but this rate decreased to 13 million ha per year for the period 1990 to 2000. In 2010, The Global Forest Resources Assessment Report claimed that about 13 million ha of forests were converted to other land uses, mainly into agricultural lands (FAO, 2010). The latest FAO report on The State of the World's Forests shows that the global deforestation rate remains the same, i.e. 13 million ha per year (FAO, 2011). These reports especially recognise that Indonesia has decreased the rate of deforestation of its tropical rainforest resources. In 2012, three days before the Earth Summit in Rio de Janeiro, the Indonesian President, S.B. Yudhoyono, delivered his speech at CIFOR headquarters in Bogor, Indonesia claiming that for the last ten years the deforestation rate in Indonesia had decreased from 3.5 million ha per year to 0.5 million ha per year (Mahamel, 2012). The decline in the deforestation rate however has not occured in all 33 provinces of Indonesia. Some provinces have a decreased deforestation rate, while

others have an upward trend. Figure II-7 shows deforestation rate in the country between 1990 and 2006.



Source: Bappenas, 2010

Figure II-7 Deforestation rates in Indonesian between 1990 and 2006

Deforestation in Indonesia is closely related to the economic and political situation of the country. Between 1996 and 2001 the deforestation rate peaked at the rate of 3.5 million ha per year (see Figure II-7). The worst period was due to the financial crises that hit Indonesia badly in 1997/1998, devastating forest fires during the same period of 1997/1998, the political instablity in 1998 when The New Order Regime was forced by the national movement to ease up power and was replaced by The Reform Regime, as well as the period when the Regional Autonomy Law came into effect in 1999/2000. Table II-6 presents research that has been done to identify and to understand the direct causes and the underlying causes of deforestation in Indonesia.

Table II-6 The causes of deforestation in Indonesia

Source	Direct and underlying causes of deforestation in Indonesia									
	Illegal Logging	**Agriculture**	**Government Policies**	**Development Project**	**Poverty**	**Economic Crisis**	**Plantation Expansion**	**Selective and clear cut logging**	**Silvopasture**	**Population growth & density**
Dauvergne, 1993	×	×	×	×						
Barber et al. 1993		×	×							
Angelsen, 1995		×	×							
Angelsen, 1999			×		×					
Palmer, 2000	×									
Contreras-Hermosilla, 2000	×		×		×					×
Sunderlin et al. 2001						×	×			
Geist & Lambin, 2002		×	×				×		×	×
Erasmi et al., 2004		×					×	×		
The World Bank, 2006		×					×			
Purnamasari, 2008		×								
The Ministry of Forestry (IFCA Report), 2008		×			×		×		×	
Fuller et al., 2010	×	×					×			
Verchot et al. (CIFOR), 2010		x					x			

*Modified and updated from Sunderlin and Resosudarmo, 1996.

As can readily be seen from Table II-6, both direct causes and underlying causes of deforestation can not be excluded from the deforestation phenomenon in Indonesia, although deforestation predominantly relates to direct causes. The direct causes referred to here are human activities, even though natural causes such as forest fires severely damaged forest areas of the country during 1982/1982 and 1997/1998. During the period 1990 – 1996, the main causes of deforestation in Indonesia were agriculture, transmigration, plantation and the timber industry (Sunderlin & Resosudarmo, 1996). Similarly, Barbier & Burgess (2001) claim that it is evident that deforestation in Indonesia is caused by human activities such as illegal logging, unsustainable agricultural activities, land conversion and mining expansion operations. The latest research into reducing forestry emissions in Indonesia conducted by a group of researchers at the Centre for International Forestry Research (CIFOR), supports deforestation in Indonesia as being driven by agricultural expansion, crop plantation development and pulpwood production (Verchot, et al., 2010). The direct causes of deforestation in Indonesia appear clear. How much each of the direct causes contributes to deforestation in each of the 33 provinces of Indonesia, however, is not well understood. Research that has attempted to describe deforestation drivers is qualitative rather than quantitative. “Few direct quantitative correlations can be made linking certain quantifiers of deforestation to particular activities” (Gao, et al., 2011).

2. Forest degradation

Unlike deforestation, defining forest degradation is much more complex. In 2000, FAO defined forest degradation as “a reduction of canopy cover or stocking within the forests” (FAO, 2003b). Further, in 2001 and 2006, FAO used the definition of forest degradation as “changes within the forests which negatively affect the structure or function of the stand or site, and thereby lower the capacity to supply products and/or services” (FAO, 2003b).

United Nations Environment Programs (UNEP) through the Convention on Biological Diversity in 2001 defined forest degradation as follows: “a degraded forest is a secondary forest that has lost, through human activities, the structure, function, species composition or productivity normally associated with a natural forest type expected on that site. Hence, a degraded forest

delivers a reduced supply of goods and services from the given site and maintains only limited biological diversity. Biological diversity of degraded forests includes many non-tree components, which may dominate in the under-canopy vegetation" (FAO, 2003b).

The International Trade and Timber Organization (ITTO) in 2002 defined forest degradation as "long-term reduction of the overall potential supply of benefits from the forest, including wood, biodiversity and other products or services", and the Inter-governmental Panel on Climate Change (IPCC) in 2003 defined forest degradation as "the overuse of poor management of forests that leads to long-term reduced biomass density (carbon stocks)" (FAO, 2003b). The Government of Indonesia (GoI) has adopted definitions of deforestation and forest degradation based on FAO definitions.

Forest degradation was internationally acknowledged as part of the proposed mechanism for reducing emissions from deforestation and forest degradation (REDD) in 2007 during the Conference of the Parties (COP 13) in Bali, Indonesia. The main reason to include forest degradation into the proposed REDD mechanism was because degraded forest land reduces its capacity to adapt to climate change and to provide ecological services and livelihood services (Murdiyarso, et al., 2008).

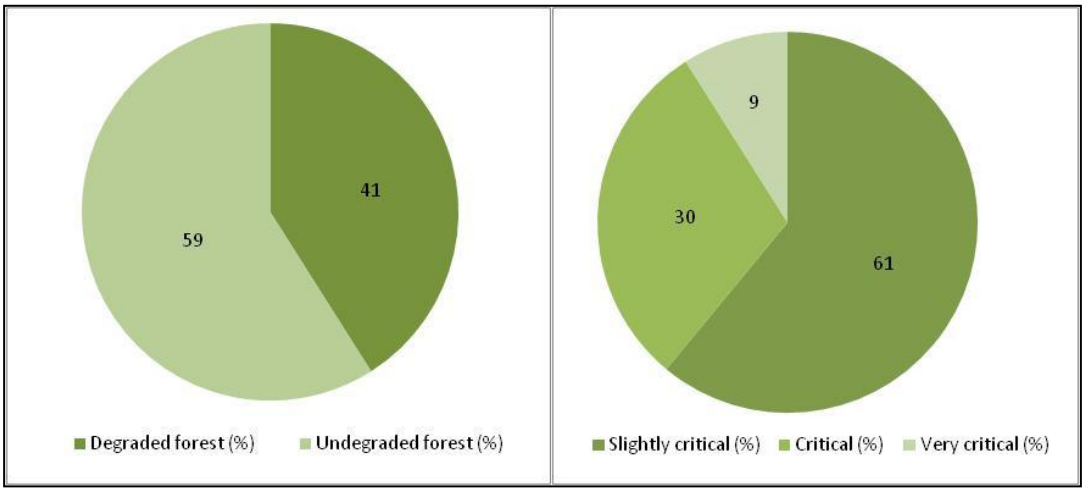
MoF has developed a classification of deforestation and forest degradation into planned and unplanned activities (BAPPENAS, 2010). In addition, selective logging, large-scale and open forest fires, collection of fuelwood and non-timber forest products, production of charcoal, grazing, sub-canopy fires and shifting cultivation are among forest degradation activities (Murdiyarso, et al., 2008). Table II-7 presents the deforestation and forest degradation activities suggested by MoF. Appendix A and Appendix B present indicators of forest degradation and deforestation initiated by different organisations.

Table II-7 The classification of deforestation and forest degradation activities

Deforestation and forest degradation		Activity
Deforestation	Planned	1. Settlement 2. Forest conversion 3. Mining 4. Plantation
	Unplanned	1. Encroachment 2. Forest fires 3. Land disputes
Forest degradation	Planned	1. Natural forest concessions 2. Industrial plantation forests (on primary forests)
	Unplanned	1. Illegal activities (illegal cutting and illegal logging) 2. Forest fires 3. Slash and burn (land clearing)

Source: BAPPENAS, 2010

By 2007, degraded forest lands in Indonesia reached 30 million ha and decreased to 27 million ha in 2011 (MoF, 2011b). The figure was presented differently by Verchot et al., (2010) who cited the source of the figure from MoF in 2009, and claimed that degraded forest land in Indonesia is 77.8 million ha (41% of the forest area of Indonesia). This area was classified into slightly critical, critical and very critical. Figure II-8 presents the degraded land in Indonesia using the categories of Verchot et al.,(2010).



Source: Verchot et al., 2010

Figure II-8 Forest cover and degraded land as a portion of the total area in Indonesia

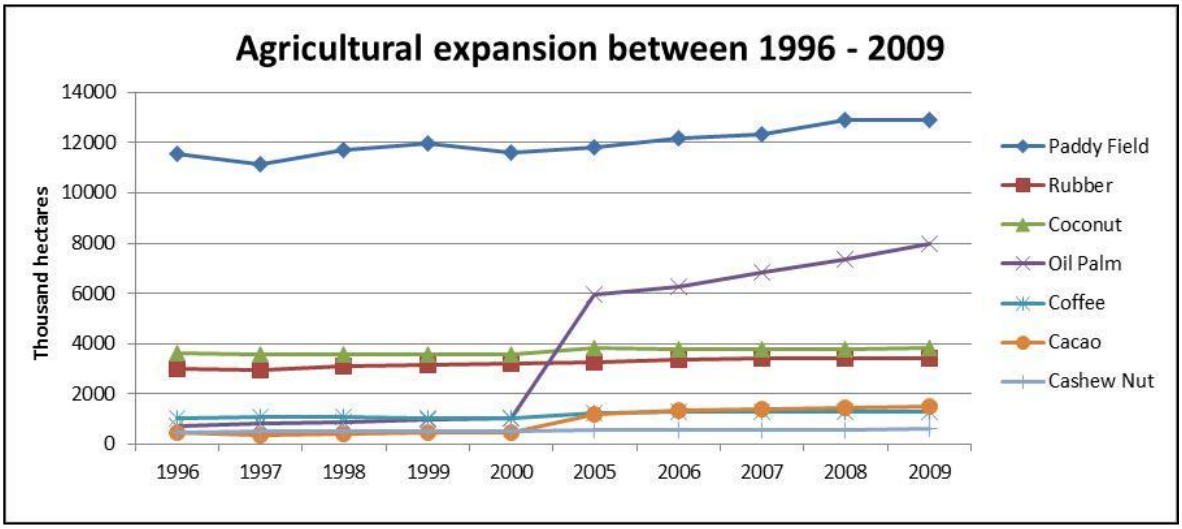
Worldwide, the problem of forest degradation is as bad as deforestation. In Brazil, forest degradation contributes 20% of the total greenhouse gas emissions; in Africa, the annual rate of forest degradation is almost 50% of the deforestation rate and in Indonesia the forest stock is decreasing by 6% per year, only one-third of which is due to deforestation (Murdiyarso, et al., 2008). MoF indicates that the forest degradation rate in Indonesia is 0.6 million ha per year (BAPPENAS, 2010). Logging activity is the single largest contributor to the rate, while other contributors to forest degradation in Indonesia have never been quantified. There has been no formal attempt by MoF to quantify forest degradation rates. Monitoring deforestation by remote sensing or by systematic forest inventory, at least is a lot easier than monitoring forest degradation (Murdiyarso, et al., 2008).

E. Land use change

The vast forest areas of Indonesia are not only utilised by forest-based activities, other sectors such as agriculture, mining and transmigration are sharing their use. Forest loss in the country is therefore highly associated with agricultural expansion, mining activities and transmigration establishment.

1. Agricultural expansion

Agricultural expansion has displaced, to some extent, forest areas in Indonesia. Between 1950 and 1992, agricultural and other land uses in Indonesia increased, while forest areas decreased (Barraclough & Ghimire, 2000). The trend however has remained the same since then. The total area of agricultural expansion (including crop plantation) in Indonesia has increased over time and to some degree of deforestation is commonly explained by agricultural encroachment (Angelsen, 1995; Gao, et al., 2011). Figure II-9 describes the agricultural expansion in Indonesia between 1996 and 2009.



Source: BPS, 2000, 2010, 2012b

Figure II-9 Agricultural expansion between 1996 and 2009

Rice is a staple food for the 230 million people of Indonesia and indeed, as the population grows the demand for rice increase from year to year. The area of agriculture and the demand for agricultural products have increased greatly due to the population growth in Indonesia (Sunderlin & Resosudarmo, 1999). As can readily be seen from Figure II-9, the area of paddy fields is increasing overtime but the country still needs to import rice from other countries, especially from Thailand. Crop plantations such as oil palm, coconut and rubber are the three most important agricultural land uses in Indonesia, and these figures are also increasing overtime (see Figure II-9). Figure II-9 also shows that in particular, oil palm plantation has expanded rapidly since 2005. In most places in the tropics, oil palm plantation only started in the last five years (Gao, et al., 2011)

The economic importance of the palm oil industries to Southeast Asia is undeniable (Koh & Butler, 2007) including to Indonesia. During the New Order (1966 – 1998), GoI started to introduce incentives to support the establishment of oil palm plantations and the program has succeeded in making Indonesia to being the country with the largest area of oil palm plantation and it is becoming a major exporter of palm oil. A tax reform introduced by the GoI (The Reform Regime; 1998 – recent time), which reduced export tax from 25% to 10% on refined palm oil

and its related products has boosted Indonesian palm oil exports to play a major role in world trade and to compete with its rival, Malaysia (Yulisman, 2013). In 2008 Indonesia exceeded Malaysia in both the area of oil palm plantation and the level of palm oil production (Koh & Wilcove, 2008).

Although oil palm expansion contributes to deforestation, peat degradation, biodiversity loss, forest fires and other social problems, the development of oil palm also contributes significant economic growth to a developing country like Indonesia (Sheil et al., 2009). Globally, between the 1980s and 2007, oil palm plantation establishment occurred on nearly 14 million ha. Many of these plantations occurred in Indonesia, where oil palm plantations grew 2100% in the same period of time (Sheil, et al., 2009). By 2009, the total area of palm oil plantations in the country was 7.6 million ha (see Figure I-9) (BPS, 2010), and the area is still growing across the provinces of Indonesia, particularly in Sumatera, Kalimantan and Papua. Between 2000 and 2009, an average of 500,000 – 750,000 ha of new oil palm plantation was established annually nationwide (BPS, 2012b). This expansion, however, has sacrificed the tropical forest cover of Indonesia (Casson, 2000). The expansion areas are several times larger than the plantation areas due to the labour migration (for settlement), plantation failure areas and abandoned plantations (Sheil, et al., 2009). High profitability ensures that oil palm plantation will be a major driver of forest loss in Indonesia for many years to come (Sheil, et al., 2009).

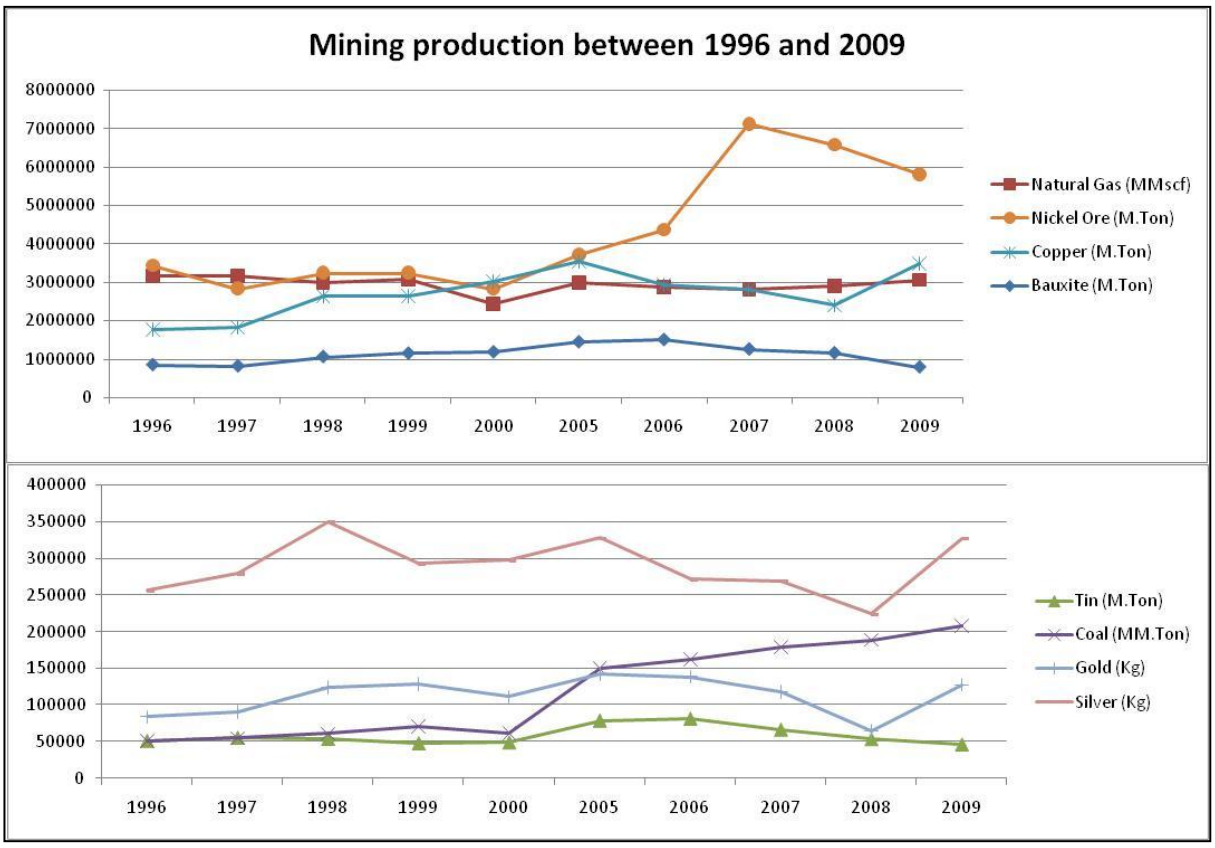
A study of the relationship between oil palm plantation establishment and deforestation indicates that oil palm plantation increased the forest degradation rate (especially in the forest areas surrounding the plantation) and intentional and unintentional forest fires (Sheil, et al., 2009). Indeed, during the devastating forest fires in Indonesia in 1997/1998, 50% of the fires started within the oil palm plantations (Kessler, 2005). In South and East Kalimantan, however, deforestation is not closely related to oil palm plantations but more to mining activities and forest concessions (Sheil, et al., 2009).

Rubber plantation establishment has contributed to a quite significant land use change of forest areas in Indonesia, although not as significantly as oil palm plantation development. The country comes second after Thailand in terms of rubber production, but has the largest area of

rubber plantation (Iskandar, 2011). In 2000, the area of rubber plantation was 3.2 million ha and increased to 3.4 million in 2009 (see Figure II-6) (BPS, 2000a, 2000b, 2010). The area increased on average of 25,000 ha per year for the same period and the area of rubber plantation in Indonesia is projected to increase because the world demand for rubber is increasing overtime (Anwar, 2006 as cited in Iskandar, 2011). Also, abundant land, especially forest areas in Indonesia, is available, enabling the development (Iskandar, 2011). Although there is a lack of adequate data to support the quantification of deforestation in Indonesia, agricultural expansion was one of the major causes (Sunderlin & Resosudarmo, 1996).

2. Mining activities

Indonesia is a major mining exporter and the sector contributes 17% of the national Gross Domestic Product (GDP) (BPS, 2010; Butt & Nottage, 2012). The country is a significant producer of coal, copper, gold, tin, and nickel (Price Waterhouse Coopers, 2010) and in terms of coal production, coal is abundant in Indonesia. It is estimated that coal deposits are 57 trillion tons (Fatah, 2008), and current production is more than 200 million tons annually (BPS, 2010). East Kalimantan has the largest deposits (35% of the national figure), South Sumatera has the second largest (33%), and South Kalimantan (16%) the third (Fatah, 2008). Figure II-10 presents mining production between 1996 and 2009.



Source: BPS, 2000, 2010

Figure II-10 Mining production between 1996 and 2009

The Forestry Law 41/1999 (FL) allows mining companies to operate within production (HP) and protected forests (HL). Closed-pit mining can take place both within HP and HL, but open-pit mining is only legally permitted within HP. This means that mining and forestry activities are operating in the same areas, and overlapping areas are allowed by the FL. Indeed, the overlap between mining and forestry activities has caused conflict between the sectors.

For the last 30 years, about 2 million ha of Indonesian forest areas have been used by the mining sector (MoF, 2009a). Mining areas are rapidly expanding, and it is estimated that in the next 10 years the areas will reach 3.3 million hectares (4% of the total HP). Monitoring mining operations is crucially important to MoF because 30 percent of the mining areas, nearly 0.6 million ha of the current figure, cannot be restored to forested land or back to its natural environment and creates degraded forest lands (MoF, 2008b). With the assumptions of this threshold of 30% and the existing regulations; if the monitoring and evaluation process and the

applied law enforcement system are not strengthened and improved, a minimum of 14 million ha of HP is likely to become unproductive, degraded and damaged ecologically by mining activities alone. This statistic reflects legal mining activities and does not take into account illegal operations that have extensively taken place throughout the Indonesian production forests. These illegal miners have occupied forestareas that have already been approved to mining companies (Widisudarmo, 2001) as well as forest concession areas.

The Ministry of Forestry Decree P.43/Menhut-II/2008 (MFD P.43/2008), dated 11 July 2008 on Forest Areas Utilization for Non-Forestry Activities regulates the mechanism to carry out non-timber activities within the forest estate, for example mining activities. Although several improvements have been made by MoF by replacing old decree MFD P.43/2008 with the new Decree No. P.18/Menhut-II/2011 dated 30 March 2011, several rules on the way MoF handles illegal exploitation activities by temporary licence holders, which were in the old decree, have been deleted. This loosening of restrictions negatively affects the forest utilization in Indonesia, particularly by the legal actors in the mining industry not to mention the illegal actors.

3. Transmigration Program

The transmigration program in Indonesia is the largest government-sponsored relocation program (Whitten, 1987) and is aimed at reducing the high population density predominantly in Java Island, and relocating the inhabitants to other islands (outer islands) such as Sumatera, Kalimantan, Sulawesi and Papua (Menakertrans, 2011). As the population density in Java Island exceeded the island's carrying capacity, people were pushed out of the region toward forested areas in the outer islands of Indonesia (Sunderlin & Resosudarmo, 1999). Between 1950 and 2011, GoI relocated at least 2.5 million people from Java, Bali and Lombok Islands, the most populous islands in Indonesia, to 4.5 million ha of forested lands across the outer islands of Indonesia (Menakertrans, 2011; Whitten, 1987). The number of migrants and areas of location are actually several times higher than the aforementioned figures. Unassisted migrations can be up to two or three times higher than the number in the government-sponsored program (Whitten, 1987). This means the forested areas that have been utilised for transmigration

programs range between 4.5 million ha and 13 million ha, including land for settlement and agricultural development for the migrants.

Inappropriate land selection for transmigration areas contributed to deforestation and forest degradation in Indonesia (Sunderlin & Resosudarmo, 1999; Whitten, 1987). Transmigration failures in the outer islands of Indonesia are responsible to some extent for deforestation and forest degradation in the country. For instance in South East Sulawesi, a settlement area of the transmigration program was on the ultrabasic soils which have a low Ca/Mg ratio, therefore rice planted died or produced no grain, leading the migrants to abandon the land and encroach on forest areas to open a new settlement area (Whitten, 1987). Inadequate income to support basic needs has forced some transmigrants to encroach on surrounding forest areas to expand their lands or to open new lands (Sunderlin & Resosudarmo, 1999).

F. Forestry related intervention programs

As international concern put more pressure on the Government of Indonesia (GoI), especially in relation to the high rate of deforestation and forest degradation of the remaining 5% of the world's tropical rainforests within the country (Sugardiman, 2007), GoI has tried enacting significant policy interventions to mitigate forestry-related problems such as deforestation, forest fires, and illegal logging. Besides policy intervention, there are a significant number of GoI programs which have been trying to improve the sustainability of Indonesia's forest resources. The programs were extensively initiated from 2001.

1. The national movement on forest and land rehabilitation

MoF introduced The Reforestation of Protected Forests Programme (*Reboisasi Hutan Lindung*) and The Rehabilitation of Degraded Areas Programme (*Rehabilitasi Lahan Kritis*) between 2001 and 2005. Furthermore, from 2003 The National Movement on Forest and Land Rehabilitation (*Gerakan Nasional Rehabilitasi Hutan dan Lahan – Gerhan/GNRHL*) has been initiated by MoF to rehabilitate production forests (HP) and protected forests (HL) nationally. Degraded forest areas are the main areas targeted as the rehabilitation locations, especially the river

catchment areas. As a national program, these intervention activities were adopted widely across the provinces and local government was actively involved in supporting these programs. MoF assigned the rehabilitation areas, and forest service offices (*Kantor Dinas Kehutanan*) at province and district level participated in validating the areas through a ground survey based on their jurisdiction (MoF, 2004).

However, the low level of tree growth in many rehabilitation locations meant that the program has failed to achieve its aims to rehabilitate the degraded areas of HP and HL. Very few of the planted trees on the assigned rehabilitation areas survived. For instance, in Wosi-Rendani protected forests of Papua, the tree growth rate was less than 20% of the target. Inadequate silvicultural treatment, incorrect planting seasons, lack of supervision during planting and maintenance periods, and lack of local people's participation were believed to be the main reasons these programs failed (Korowotjeng, 2007).

In Lampung Province, at the tip of Sumatera Island, there have been on-going social conflicts because the under storey coffee trees of local people were cut down and replaced by exotic tree species for conservation. Indeed, local people lost their source of income from the coffee plantation and the forest of the area has continued to degrade because it was not supported by the local people (Noordwijk, et al., 2007). Ironically, in Maluku, due to the lack of dissemination to the locals, trees were cut down in order to prepare planting areas for the rehabilitation program (Korowotjeng, 2007). Rather than focusing on achieving the aims of conserving the forest resources and restoring degraded forests, MoF only focused on the number of trees planted and the number of allocated rehabilitation areas.

2. The national movement on planting trees

The national movement on planting trees was initiated by the former Minister of Forestry, MS. Kaban, in 2009. The first program was The One Man One Tree Program (*Gerakan Satu Orang Satu Pohon*), and aimed to plant as many as 200 million trees, equal to the country's population size in 2009. The latest program started in 2010 and has becoming a national yearly agenda since then. The program is called The One Billion Indonesian Trees Program (*Gerakan*

Menanam 1 Milyar Pohon) and GoI have been trying to alleviate forest degradation and deforestation by initiating a tree planting program on degraded forests. These anti-deforestation efforts are supported in cooperation with central government, local government and stakeholders. MoF claimed that the areas of degraded forests decreased from 59 million ha in 2005 to only 30 million ha in 2009 (MoF, 2009d). The institution also claims that in 2007 86 million trees were planted, and another 107 million trees in 2008 (MoF, 2009d). Like other forest and land rehabilitation programs introduced earlier, MoF only focused on the planting stage without following this up with a proper maintenance program. Tree growth rates were very low across the project sites and indeed most of the trees from the program were dying. Successful cases of reforestation programs in Indonesia are rare (Alimuddin, 2012; Siregar, Rachmi, Massijaya, Ishibashi, & Ando, 2007).

3. The establishment of community-based plantation

In 2007, MoF started to introduce a new scheme for forestry activities that acknowledges local participation. The program is designed for the 5.4 million ha of logged over areas and degraded areas of production forests (HP), and is aimed at creating job opportunities for the rural population, improving local participation in forest management, lifting pressure off the natural forests, and meeting the national wood supply for forest industries (MoF, 2007). This new program is called community-based plantation (*Hutan Tanaman Rakyat – HTR*) and promotes pro-poor, pro-job and pro-growth (MoF, 2007). HTR has three different schemes; personal licence, cooperative licence and developer licence; the holder will be given a minimum of a 15 ha concession per household, up to 100 years concession, and at a maximum of eight million rupiah per hectare (equal to NZ$ 1,143 per hectare) in the form of a soft loan to establish plantation (MoF, 2007). GoI has set a target of 360,000 households participating in HTR with a total budget 43.2 trillion rupiah (MoF, 2007; Noordwijk, et al., 2007).

By 2011, MoF assigned 650 thousand ha of potential HTR location. Among those, only 1,852 licence holders were granted concessions covering 126,295 ha (MoF, 2011b). This low level of participation is due to the lack of institutional arrangements and problems in designated areas. The latest Minister of Forestry Decree (MFD) 55/2011 promulgated the mechanism of applications for community-based plantations but this is not fully aligned with local government

policies. Extension and financial support for this program is barely acknowledged by the local policy makers and creates barriers for local people to participate (Syamsiatun, 2011). This Decree also asserted that areas that have been assigned as a potential HTR location by MoF should be granted to a HTR licence holder by the local government within two years otherwise MoF has the right to change the designation for other forestry uses. The short timeframe is difficult to meet by local government, especially with problems such as land title problems, non-synchronised policies, and lack of institutional support failing the process (Siregar, et al., 2007; Syamsiatun, 2011).

4. REDD+ activities

Reducing Emission from Deforestation and forest Degradation (REDD) was first proposed in 2007 during the Conference of the Parties (COP 13) to the United Nations Framework Convention on Climate Change (UNFCC) in Bali, Indonesia. The conference agreed that it is imperative to mitigate carbon emissions from the forestry sector and countries (developed and developing) were urged to take immediate actions to reduce emissions from deforestation and forest degradation (REDD-I, 2012a). The action plan was called the Bali Roadmap, and the plan was the first document that acknowledged the problem of forest degradation which was included in the proposed REDD mechanism (Madeira, Sils, Brockhaus, Verchot, & Kanninen, 2011). The 'plus' sign was added into REDD (REDD+) to include the mechanism to increase carbon sequestration from forests in developing countries (REDD-I, 2012a).

By 2009, there were 109 REDD+ initiatives worldwide including 44 demonstration activities and another 65 projects are designed to support enabling the REDD+ framework. REDD is a financial mechanism to compensate developing countries which can reduce carbon emissions from forest degradation and deforestation (REDD-I, 2012b). The President of Indonesia, S.B. Yudhoyono, committed to decreasing the carbon emissions from the Indonesian forestry sector between 26% and 41% with the support and assistance of international communities (DNPI, 2011). Indonesia will be an important supplier for the REDD+ mechanism (Murdiyarso, et al., 2008) and the country has gained international commitments to help GoI to achieve REDD+ initiatives. By mid 2009 there were 17 sites established in Indonesia, increasing to 44 sites by

October 2010 (REDD-I, 2012a). The sites are distributed across 14 provinces, although the highest number of REDD projects are established in East Kalimantan.

Key actions of GoI in relation to supporting the REDD+ mechanism:

- Formatted the Indonesian Forest Climate Alliance (IFCA) in 2007. The alliance released a consolidation report in 2008 on REDD in Indonesia.
- Established the Climate Change National Council (Dewan Nasional Perubahan Iklim – DNPI) in 2008.
- Enacted government regulation through the Minister of Forestry Decree (MFD) 30/Menhut-II/2009 on procedure for REDD and MFD 36/Menhut-II/2009 on licensing of commercial use of carbon sequestration and store in production forests (HP) and protected forests (HL).
- Signed a Letter of Intent with the Kingdom of Norway in 2010 to support the REDD+ activities.
- Introduced a moratorium licensing in primary natural forests and peatlands in 2011.

Global commitments on meeting emission reduction obligations have not been achieved yet, and uncertainty about the international carbon trading market does persist. There is also domestic uncertainty such as lack of clarity in the national institutions and the national regulatory complexity. However, international communities, donors and investors have seen the potential of Indonesian forest areas as a long term investment in the name of REDD+ (Madeira, et al., 2011). This financial support from REDD mechanisms can be used by GoI to support conservation programs, forest protection activities and to help alleviate poverty (Koh & Butler, 2007).

However, as one of the major palm oil producers, Indonesia will have difficulties in choosing between REDD and palm oil expansion. An economic analysis has compared different scenarios to evaluate returns from REDD and palm oil plantation as a land use option. The result suggests that a carbon price at US$18 – 46 per ton of CO_2 would be needed to outweigh palm oil from REDD activities (Koh & Butler, 2007). The research shows that under the current carbon price palm oil plantation is the best land use and remains more profitable than REDD sites. The Net Present Value (NPV) of a REDD project in the existing scenario (voluntary carbon market)

ranges from US$ 614 to 994 per ha compared to NPV from palm oil plantation that ranges from US$ 3,835 to 9,630 per ha (Butler, Koh, & Gazoul, 2009).

A REDD+ initiative called 'Rimba Raya Reserve REDD Project' is a REDD+ project funded by Gazprom (the huge Russian gas producer) and Alllianz (a German financial-services giant) and is designed to preserve forest areas in Central Kalimantan the size of Singapore; 91,000 ha of natural and peat forests . It is estimated that the project will receive 104 million carbon credits; worth as much as US$ 500 million at current market price. GoI would receive hundreds of millions of dollars from the project to support conservation and poverty alleviation, and this initiative would prevent nearly 100 million tons of CO_2 emission. GoI, however, has decided to change the commitment and turn more than half of the area over to Best Group Ltd., a palm oil plantation (Banyan, 2012). The approval from MoF allocated the area to Best Group Ltd. two days before GoI enacted the two years moratorium on new licences on primary natural forests and peatlands (Fogarty, 2011).

5. Moratorium on forestry licence in natural forests and peat areas

In 2011, the Government of Indonesia (GoI) enacted the Presidential Instruction (*Inpres*) 10/2011 that regulated a moratorium on new licences on primary natural forests and peatlands (MoDA, 2011). This was to follow up the Letter of Intent between GoI and the Kingdom of Norway that was signed on 26 May 2010. According to this LoI, GoI agreed to develop REDD+ National Strategy, to establish a dedicated agency to implement REDD+ strategy, including a system for measurement, reporting, and verification (MRV) of emission reductions and financial instruments for disbursing funds; and to develop and implement policy instruments and enforcement capability, including a two year suspension of all new concessions for forest concessions, mining, and agricultural expansion (Kirana, 2012a; Murdiyarso, Dewi, Lawrence, & Seymour, 2012). In return, the Norwegian government pledges to support these actions financially by providing US$ 1 billion to GoI (Kirana, 2012a).

This Inpres 10/2011 is supported by an indicative map on suspension areas in primary natural forests and peatlands covering 72 million ha. The map is prepared by MoF and revised every six months to ensure the reliability and validity between the map and on ground activities(Kirana,

2012b). The latest version of the map (the 3rd revision version) was launched in November 2012 covering only 65 million ha (Kirana, 2012b). This moratorium program has shed light on Indonesian forestry management, although two different groups of stakeholders in Indonesia do not support this decision; the business community and the environmental community. The former is against the Inpres as they perceived this will be counter-productive for the economic development of the country, while the latter does not support it because the Inpres does not include secondary forests as part of the moratorium areas (Murdiyarso, et al., 2012).

The indicative map of each province is widely distributed in central government particularly to institutions that deal with land-based activities such as the Ministry of Forestry and the National Land Agency, as well as to all local governments at provincial and district levels, to ensure the suspension program is adopted nationally. The moratorium, however, excludes the Ministry of Agriculture and the Ministry of Energy and Natural Resources Management from this instruction and allows these institutions to grant a new concession exclusively for supporting food security and energy security projects (Murdiyarso, et al., 2012).

In 2013, the Inpres will end as the duration only covers a 2 year period. The Minister of Forestry has shown an interest in supporting the extension of the program, but there is no clear signal that the Indonesian President is willing to extend this program (Mahatma, 2012). The upcoming 2014 presidential election is suspected to be a strong reason for President Yudhoyono not to prolong the Inpres in order to gain financial support from the business community.

G. Summary of the chapter

As one of the few countries in the world with mega-diversity, Indonesia has a pervasive problem with deforestation and forest degradation. Between 1996 and 2001 the deforestation rate in Indonesia peaked at the rate of 3.5 million ha per year. This was due to the 1997/1998 global financial crisis, domestic political instability when the New Order Regime eased up on power in 1998, the enactment of the Regional Autonomy in 1999/2000 and devastating forest fires in 1997/1998. In 2012, the Government of Indonesia (GoI) claimed that the rates of deforestation and forest degradation have decreased to 0.5 million ha per year; however the

downward rate is not occurring in all of the 33 provinces. No comprehensive study has been conducted to quantify factors that cause deforestation and forest degradation.

Several policy interventions to support forest conservation and rehabilitation programs have also been initiated by GoI, but lack of a dissemination program, lack of coordination and non-synchronised policy between central and local governments, as well as economic pressures and political deals have limited the success of these interventions programs. Reducing deforestation and forest degradation rates in Indonesia is indeed challenging.

A wide range of research has been carried out and the results show that the direct and underlying causes of deforestation and forest degradation are clear, and both of these forest problems occur in Indonesia. Most of the results support the view that political and economic pressures contribute most to the deforestation and forest degradation of Indonesia. A high population density, agricultural and plantation expansion, government-sponsored relocation programs, unsustainable practices from forest concession companies, land title conflicts, mistaken policy interventions, illegal activities, mining activities, ineffective and inefficient forest management, and natural disasters such as forest fires are among the causes of deforestation and forest degradation in Indonesia. Direct causes are predominantly triggering deforestation and forest degradation; however almost no quantitative studies have been conducted to relate deforestation and forest degradation to these direct causes. The case studies in East Kalimantan, South Kalimantan, and SE Sulawesi attribute the relationship between deforestation and forest degradation to different direct and underlying causes.

III. Methodology

This chapter explains the methodology applied to the study. Study locations and data collection methods are described and the research design is discussed, followed by a description of the data processing steps and statistical analyses used to answer research questions.

A. Selection of study location

The study aims to quantify forest degradation and deforestation using GIS software to analyse the land cover change between 2000 and 2009. The selection of the study location, therefore, is highly dependent on the availability of spatial information.

There are 33 provinces in Indonesia and each province has different characteristics. Not all of these provinces are spatially well-informed. Potential mining, for example, is available spatially in the Ministry of Forestry (MoF), particularly in the Directorate General of Forest Utilization (*Direktorat Jenderal Bina Usaha Kehutanan*), only for four provinces namely Jambi, South Kalimantan, East Kalimantan and South-east Sulawesi (SE Sulawesi). The options for choosing the study location, therefore, are limited to these four provinces. A set of characteristics was chosen to select study locations representing the diversity of the country with regards to forest degradation and deforestation issues. The characteristics included the availability of spatial data, forest cover and population density.

Table III-1 Forest cover and population density in 2000/2001

Province	2000 / 2001	
	Forests Cover (%)*	Population Density (ppl/sq m)**
Jambi	30	45
South Kalimantan	28	82
East Kalimantan	74	12
SE Sulawesi	57	48

Source: *MoF, 2012 ** BPS, 2010

Forest cover and population density were used to refine the potential list of study sites. Table III-1 indicates that Jambi has a similar forest cover to South Kalimantan and a similar population

density to SE Sulawesi. Among the other four provinces, in 2000/2001, South Kalimantan has the highest population density and East Kalimantan has the highest forest cover. This means that South Kalimantan and East Kalimantan should be retained on the list, and either Jambi or SE Sulawesi should be removed from the list. Because Jambi and South Kalimantan have a similar forest cover it was decided that South Kalimantan would be retained, and the decision was made not to include Jambi in the analysis. This is also consistent with the geographic location of Jambi which is located in Sumatra Island, the western part of Indonesia. Kalimantan is relatively closer to Sulawesi compared to the distance from Kalimantan to Sumatera.

Based on the chosen characteristics, three provinces, namely South Kalimantan, East Kalimantan and SE Sulawesi were selected as the study locations (see Figure III-1).These three provinces cover 39 districts and 526 sub-districts (see Table III-2). Detailed information on the study sites' geographic, economic and, particularly, land uses are presented in Chapter 4.

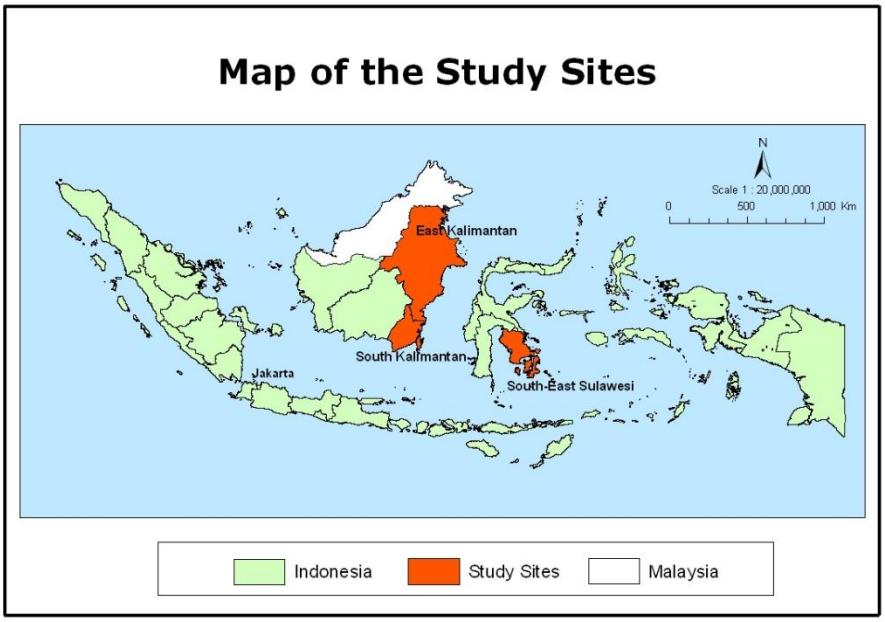


Figure III-1 Map of study locations

Table III-2 Number of districts and sub-districts of chosen provinces

No.	East Kalimantan*		South Kalimantan*		SE Sulawesi*	
	District/City	Number of Subdistricts	District/City	Number of Subdistricts	District/City	Number of Subdistricts
1	Paser	15	Tapin	12	Wakatobi	8
2	Kutai Barat	21	Tanah Laut	11	Muna	39
3	Kutai Kartanegara	18	Tanah Bumbu	10	Konawe	30
4	Kutai Timur	19	Tabalong	12	Konawe Utara	7
5	Berau	13	Kotabaru	25	Konawe Selatan	22
6	Malinau	12	Hulu Sungai Utara	16	Kolaka	23
7	Bulungan	11	Hulu Sungai Tengah	11	Kolaka Utara	15
8	Nunukan	9	Hulu Sungai Selatan	11	Bombana	22
9	Penajam Paser Utara	4	Barito Kuala	19	Buton	31
10	Tana Tidung	3	Banjar	19	Buton Utara	6
11	Balikpapan (C)	5	Balangan	8	Kendari (C)	10
12	Samarinda (C)	6	Banjarmasin (C)	5	Bau-bau (C)	7
13	Tarakan (C)	4	Banjarbaru (C)	6	-	-
14	Bontang (C)	3	-	-	-	-
		143		165		220

(C) City *Source: BPS, 2011

B. Materials and data collection method

The Indonesian Ministry of Forestry, where I have been working, and The NZ School of Forestry, University of Canterbury provided supporting letters to conduct the field visit. A research supporting letter is an essential document[3] for conducting field research in Indonesia.

This field research was conducted from September – December 2011. For several reasons, there was a delay and slow progress in collecting data for this study.

Visits to the capital city of every selected province were arranged to collect data and information as given in Table III-3. A special arrangement was also made to visit national institutions based in Jakarta, the capital of Indonesia.

[3]The letter is required formally by both central and local institutions. The letter should be addressed to, and approval should be sought from the head of the institution or head of department before it is forwarded to the relevant department or unit. The process to get an approval and to get the required data varies depending upon the presence of the personnel is in charge to approve or to handle the data.

Table III-3 Data collection from field visits

Data/Information	Name of Institution/Organisation	Acronym	Type of Data
Land use (Tabular): • **forests concessions** • **transmigration areas** • **road network** • **forest infrastrucures** • **agricultural land** • **crop plantation** • **mining sites**	- The National Statistics Agency at central and localbranches - The Ministry of Forestry - Provincial Forestry Service Office	BPS MoF FSO	- **Spatial (Softcopy)** - **Non-spatial (softcopy and hardcopy)**
Maps of forest concessions (natural concessions, industrial plantation concessions, and community-based plantations)	- The Directorate of Inventory and Monitoring of Forest Resources (*Direktorat Inventarisasi dan Pemantauan Sumber Daya Hutan*)	DIPSDH (MoF)	- **Spatial**
Maps of transmigration areas	- The Directorate of Inventory and Monitoring of Forest Resources (*Direktorat Inventarisasi dan Pemantauan Sumber Daya Hutan*)	DIPSDH (MoF)	- **Spatial**
Maps of road network	- The Directorate of Inventory and Monitoring of Forest Resources (*Direktorat Inventarisasi dan Pemantauan Sumber Daya Hutan*)	DIPSDH (MoF)	- **Spatial**
Maps of forest infrastructures	- The Directorate of Inventory and Monitoring of Forest Resources (*Direktorat Inventarisasi dan Pemantauan Sumber Daya Hutan*)	DIPSDH (MoF)	- **Spatial**
Maps of Mining sites	- The Directorate of Inventory and Monitoring of Forest Resources (*Direktorat Inventarisasi dan Pemantauan Sumber Daya Hutan*)	DIPSDH (MoF)	- **Spatial**
Maps of potential mining	- The Directorate of Planning and Utilisation of Production Forests (*Direktorat Bina rencana Pemanfaatan Hutan Produksi*), The Ministry of Forestry	BRPHP (MoF)	- **Spatial**
Maps of potential agriculture and crop plantation	- The Indonesian Centre for Agricultural Land Resources Research and Development (*Balai Besar Sumber Daya Lahan Pertanian*), The Ministry of Agriculture	BBSDL (MoA)	- **Spatial**

Land system maps	- The Directorate of Inventory and Monitoring of Forest Resources (*Direktorat Inventarisasi dan Pemantauan Sumber Daya Hutan*)	DIPSDH (MoF)	-
Land cover (time series 1990, 2000, 2003, 2006, 2009 and 2011)	- The Directorate of Inventory and Monitoring of Forest Resources (*Direktorat Inventarisasi dan Pemantauan Sumber Daya Hutan*)	DIPSDH (MoF)	- **Spatial** - **Non-spatial**
Forest utilisation regulations	- The Ministry of Forestry - The Ministry of Energy & Mineral Resources - The Ministry of Agriculture - Provincial Forestry Service Office	MoF MoEMR MoA FSO	- **Spatial** - **Non-spatial**
Demographic data (Number of population)	- The National Statistics Agency at central and localbranches	BPS	- **Non Spatial**
Demographic data (Number of poverty people)	- The National Agency for Population and Family Planning Programmes (*Badan Kependudukan dan Keluarga Berencana Nasional)*	BKKBN	- **Non Spatial**
Districts and sub-districts data (administrative boundaries, geographic condition etc)	- The National Statistics Agency at central and local branches - The Ministry of Forestry	BPS MoF	- **Spatial** - **Non-spatial**
Other data and information related to forestry issues	- **The National Statistics Agency at central and local branches** - **The Ministry of Forestry** - **The Ministry of Energy & Mineral Resources** - **The Ministry of Agriculture** - **Provincial Forestry Service Office**	**BPS** **MoF** **MoEMR** **MoA** **FSO**	- **Non Spatial**

Visits to the nearest forest areas from the capital city of every chosen province were arranged to observe land use changes. This observation was made in order to see how much deforestation and forest degradation have altered the existence of forest in the study site areas. A global positioning system (GPS) which included official forest area (forest estate) maps was used to locate forest estate boundaries and non-forest areas. No formal interviews were undertaken with the locals. Figure III-2 shows the field photographs of study sites.

Field photographs of East Kalimantan (a – c), SE Sulawesi (d – g) and South Kalimantan (h – k): (a) Dipterocarp. Spp Log at Wood Museum in Tenggarong, Kutai Kartanegara District; (b) Coal Mining within Production Forests, Kutai Kartanegara District; (c) Production Forests at Bukit Bangkirai, Balikpapan Municipality; (d) Land clearing in Conservation Forests, Kendari Municipality; (e) Clove Plantation within Conservation Forests, Kendari; (f) Local people's activities within Conservation Forests, Kendari; (g) Production Forests, Konawe Selatan District; (h) Rubber Plantation, Barito Kuala District; (i) Logging and mining road infrastructure within Production Forests; (j) Paddy Field, Banjar District; (k) Peat land, Banjar District.

Figure III-2 Field visit photographs

The locations of forest areas in which to observe land use change were sought from the Provincial Forestry Service Office (*Kantor Dinas Kehutanan Provinsi*). Meetings with relevant officers to discuss options for field visits were arranged in Kendari (the capital of SE Sulawesi), Banjarmasin (the capital of South Kalimantan) and Banjarbaru, where most South Kalimantan provincial offices are located, and Samarinda (the capital of East Kalimantan). The officers, however, were reluctant to provide information on where illegal activities occur. Criteria applied were:

- The nearest forest areas from the capitals;
- Forest areas that had been converted into agricultural land, crop plantation areas, transmigration villages, forest concessions, mining sites and other land uses;
- Good accessibility;
- Free of conflicts. This is to minimise risk during field visits.

Vector data of land cover for the years 1990, 2000, 2003, 2006, 2009 and 2011 were obtained from MoF. This study, however, only focused on land cover in 2000 and 2009 as the major resources, although land cover data for 1990 was also used to help understand the trend of forest degradation and deforestation of the study sites.

In dealing with spatial data, there are two types of data to represent the geographical information of the real world: vector data and raster data. The former provides a vector view, which allocates coordinates (x, y) in the form of point, line or area (polygon) to form a map (O'Sullivan & Unwin, 2010). The latter defines objects on the ground using a grid of small units, called pixels (O'Sullivan & Unwin, 2010). Polygons represent areas that have boundaries (countries, lakes and forest areas), lines represent linear objects (roads, rivers and pipelines), and points represent subjects with limited spatial extent (this depends on map scale, but can include cities, schools and individual trees) (Ormsby, Napoleon, Burke, Groessl, & Bowden, 2010). Polygons, lines and points are called vector data (Ormsby et al., 2004). Figure III-3 describes vector and raster data.

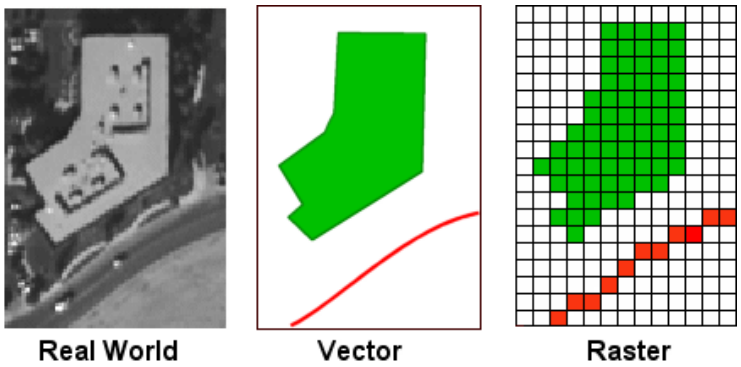


Figure III-3 Vector and raster data
(www.geography.hunter.cuny.edu)

C. Research design

This research was quantitatively conducted in three phases. Figure III-4 shows the general flow of this study. The first phase was to analyse vector data of land cover year for the years 1990, 2000 and 2009 using ArcGIS ver. 10, a GIS software, to locate degraded and deforested areas and to produce land use matrix. Forest degradation and deforestation rates were also determined using the same vector data. Then, the maps of forest degradation and deforestation were generated using GIS software and presented at provincial level.

Later, coefficient correlation was determined using statistical softwares; SPSS ver. 17.0 (SPSS Inc., 2008) and R ver. 2.15.1 (R Core Team, 2012). The analysis was carried out to define the association between dependent variables: forest degradation and deforestation, and their explanatory variables: population density, poverty, potential agriculture, potential mining, potential agriculture plantation, forest concessions, community-based concessions, transmigration areas, slope, and road infrastructure.

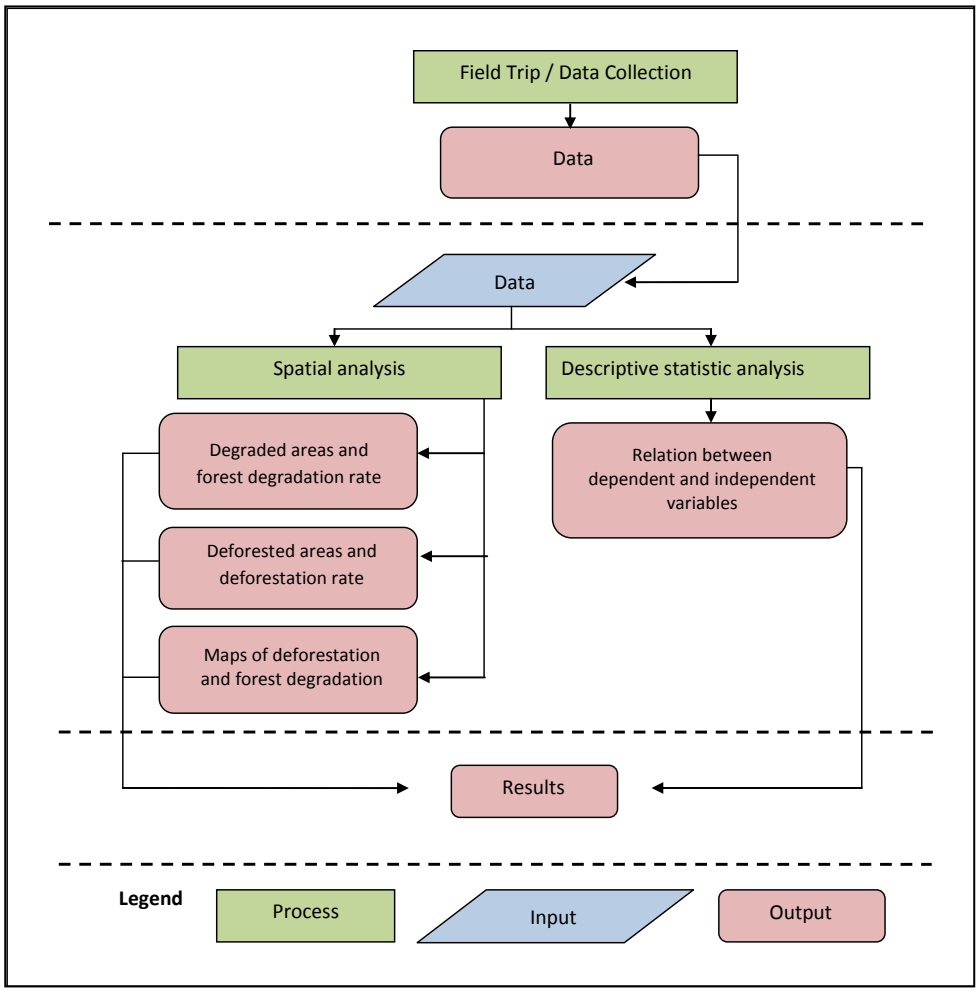


Figure III-4 General flow of the study

D. Data processing and analysis

This section provides information on the data processing of land use classification, population density, and poverty; as well as analysis of deforestation, forest degradation and descriptive statistical analysis.

1. Land use classification

The Indonesian MoF established the National Land Use Standard which consists of 23 classes (MoF, 2008a). The Centre of Mapping and Forest Inventory (*Pusat Inventarisasi dan Perpetaan Kehutanan/ PIPK*) of Forest Planning Agency (*Badan Planology Kehutanan*) of MoF uses the

classification for defining national land cover starting in 1960 using aerial photograph techniques. It was in 1990 that the forest inventory started periodically utilizing moderate remotely-sensed resolution (30 metre). The inventory was conducted every three years, in 2000, 2003, 2006, 2009, and onwards regularly (MoF, 2008a). There are 217 scenes needed to portray the national land cover to support this inventory program. In general, aerial imagery for the regions has moderate resolution, but high resolution is available for specific areas for specific purposes (MoF, 2008a).

The interpretation of 217 scenes covering all areas of Indonesia is designed as a bottom up approach. MoF delegates the inventory program to The Forests Establishment Unit (*Balai Pemantapan Kawasan Hutan/ BPKH*) based across all provinces in Indonesia. BPKHs are responsible for interpreting the scenes covering their working areas and conducting random ground checking to verify the accuracy, and produces land cover maps at the provincial level. PIPK then compiles the results as an aggregation of national land cover maps. The land cover data is available in the form of vector data (shape files), which other internal users can request for further analyses.

Because Indonesia is equatorial and persistent cloud cover is unavoidable (Sugardiman, 2007; Broich et al., 2011), remotely-sensed inventory is challenging. Extra scenes are required to cover the cloud covered areas to reveal its land uses, especially after 2003 when the Scan Line Corrector (SLC) of Landsat 7 ETM+ was not operated perfectly (MoF, 2008a; USGS, 2003). More scenes from Landsat 7 ETM+, Landsat 5 TM and SPOT-4 are used extensively to support the forest monitoring and inventory programs (MoF, 2008a).

To provide forest reference emission level (REL) for implementation of REDD+ (Reducing Emissions from Degradation and Deforestation) activities, MoF reclassifies its national standard to meet the Intergovernmental Panel on Climate Change (IPCC) standard. IPCC only classifies land cover into six different land uses (BAPPENAS, 2010). Table III-4 defines a new reclassification of national land use standard for meeting the IPCC criteria.

Table III-4 Reclassification of the national land use standard meeting IPCC's criteria

No.	Indonesia national standard		IPCC's criteria/A new reclassification of the national standard	
	Code	Class		
1	2001	Primary Forests	Forestland	1
2	2004	Primary Mangrove Forests		
3	2005	Primary (Peat)Swamp Forests		
4	20041	Secondary Mangrove Forests		
5	20051	Secondary (Peat)Swamp Forests		
6	2002	Secondary Dryland Forests		
7	2006	Plantation Forests		
8	2007	Bush/Shrub	Grassland	2
9	3000	Grassland		
10	20092	Mixed-Dryland Agriculture	Cropland	3
11	20091	Dryland Agriculture		
12	20122	Transmigration Areas		
13	20093	Paddy Field		
14	2010	Crop Plantation		
15	50011	(Peat)Swamp	Wetland	4
16	20071	Swamp/Shrub		
17	2012	Housing/Built-up Area	Settlement	5
18	2014	Barren Land	Other Land	6
19	20141	Mining Areas		
20	20094	(Fish)Pond		
21	20121	Airport		
22	5001	Water Body		
23	2500	Cloud covered areas		

Instead of using national land use standards or IPCC classification, a new aggregation land use class was suggested for this study. The classification for this study has 10 new classes and was used to identify forest degradation, deforestation, and to determine rates of change. Table III-5 presents the new aggregation land use class for the purpose of this study.

All different types of primary forest such as primary mangrove forests and primary peat (swamp) forests are classified into primary forests (class 1). Similarly to primary forests, different types of secondary forests are also classified into secondary forests (class 2). Plantation forests are separated from secondary forests and are assigned into a different class;

plantation forests (class 3). These three classes: primary forests, secondary forests and plantation forests, constitute what this study refers to a forest.

Non forests were classified into seven different classes: bushland, agriculture, paddy field, mining areas, crop plantation, settlement, and others (see Table III-5). Bushland (class 4) consists of grassland and bush/shrub. Swamp/shrub is not part of bushland but is classified into others (class 10) because the majority of swamp/shrub is swampy areas and different from bushland.

Different types of agricultural activities such as mixed-dryland agriculture and dryland agriculture were classified into the agriculture classification (class 5). Fish pond is also part of it because fish and other related products are part of agricultural products (BPS, 2000b). Paddy field and crop plantation were separated from agriculture. These new classes: paddy field (class 6) and crop plantation (class 8) allow identifying land use change from forest area to other land uses such as paddy field, crop plantation, and agriculture separately.

Mining areas and barren land were categorised into one single class; mining areas (class 7). This was because of the difficulties in differentiating barren land from mining sites based on aerial imagery that has moderate resolution. Without a proper knowledge of the area, it will be difficult to differentiate mining sites from barren land.

Settlement (class 9) covers all built-up areas such as housing and transmigration areas as well as airports. All other classifications such as water body (river, lake, creek), peat (swamp), swamp/shrub and cloud covered areas that were not suit to the 9 classes aforementioned were classified into 'others' (class 10).

Table III-5 Land use classes for this study

No.	Indonesia National Standard		This Study (New Aggregation)	
	Code	Class		
1	2001	Primary Forests	Primary Forests	1
2	2004	Primary Mangrove Forests		
3	2005	Primary (Peat)Swamp Forests		
4	20041	Secondary Mangrove Forests	Secondary Forests	2

5	20051	Secondary (Peat)Swamp Forests		
6	2002	Secondary Dryland Forests		
7	2006	Plantation Forests	Plantation Forests	3
8	2007	Bush/Shrub	Bushland	4
9	3000	Grassland		
10	20092	Mixed-Dryland Agriculture	Agriculture	5
11	20091	Dryland Agriculture		
12	20094	(Fish)Pond		
13	20093	Paddy Field	Paddy Field	6
14	2014	Barren Land	Mining Areas	7
15	20141	Mining Areas		
16	2010	Crop Plantation	Crop Plantation	8
17	2012	Housing/Built-up Area	Settlement	9
18	20122	Transmigration Areas		
19	20121	Airport		
20	5001	Water Body	Others	10
21	50011	(Peat)Swamp		
22	20071	Swamp/Shrub		
23	2500	Cloud covered areas		

2. Population density

Demographic data was acquired from central and provincial offices of the National Statistics Agency (BPS). Sub-districts in Numbers (*Kecamatan dalam Angka*), District in Numbers (*Kabupaten dalam Angka*), Province in Numbers (*Provinsi dalam Angka*) and Indonesia in Numbers (*Indonesia dalam Angka*) are documents produced by BPS on a yearly basis. The documents generally provide detailed information such as geography, climate, demography, and socio economic information at village, sub-district, district, province, or national level (BPS, 2010). Equation 1 defines population density per square km at sub-district level.

Equation 1. Population density

$$\text{Population Density Year X} = \frac{\text{Total villagers in each sub-district}}{\text{Total area of sub-district (km}^2\text{)}}$$

3. Poverty

In Indonesia, institutions such as the National Statistics Agency (*Badan Pusat Statistik/ BPS*), the National Agency for Population and Family Planning Program (*Badan Kependudukan dan Keluarga Berencana Nasional/BKKBN*), the Ministry of Social Affairs (*Kementerian Sosial/KEMENSOS*) publish poverty figures on an annual basis. BPS and KEMENSOS publish the figures at province or district level, while BKKBN is the only national institution that provides these figures at the level of sub-district or village. International organisations such as the World Bank/UNEP/UNFPA also provide poverty figures for Indonesia at province or country level.

To acquire the sub-district poverty figures, the definition of poverty standardised by BKKBN was adopted for the purpose of this study. BKKBN uses family as the survey unit and applies a family welfare approach to identify families in poverty (BKKBN, 2011).

BKKBN classifies family welfare into the following five classes:
(1) Pre-Welfare Family (Very poor)
(2) Family Welfare I (Poor)
(3) Family Welfare II
(4) Family Welfare III
(5) Family Welfare III Plus.

Families in poverty fall into categories 1 and 2; Pre-Welfare Family and Family Welfare I, added up altogether (BKKBN, 2011). A pre-Welfare Family (Very poor) is defined as a family that cannot meet its basic needs for food, health, housing, education and basic clothing. Family Welfare I (Poor) is defined as a family that cannot meet its basic needs at the minimal standard without meeting the socio-psychological needs (BKKBN, 2011). The socio-psychological needs include interactions with family, people and environmental surroundings, and access to education, family planning programs, and public transport (Cahyat, 2004). Equation 2 defines the percentage of families in poverty at the sub-district level.

Equation 2. Percentage of Familis in Poverty

$$\text{Poverty Families Year X} = \frac{\text{Total Pre-Welfare Family + Total Family Welfare 1}}{\text{Total families per sub-district}} \times 100\ \%$$

4. Forest degradation, deforestation and their rates

a) Forest degradation and deforestation

Forest degradation and deforestation are interpreted differently and defined widely. The Government of Indonesia adopts definitions of both deforestation and forest degradation that are defined by the United Nations for Food and Agricultural Organisation (FAO).

Reforestation is defined by FAO as “artificial establishment of forest on lands that carried forest before” and IPCC promotes the definition as “planting of forests on lands that have previously contained forests but that have been converted to some other use”.

Figure III-5 shows deforestation as a conversion from primary forests, secondary forests and plantation forests to non-forested areas. Reforestation, otherwise, is a restoration of non-forested areas to primary forests, secondary forests and plantation forests. Figure III-5 also depicts forest degradation which is when primary forests are altered to secondary forests or plantation forests.

For the purpose of this study, forest degradation only focused on the alteration from primary forests to secondary forests, and deforestation refers to all conversions from secondary forests to other land uses (see Figure III-5). This study uses ‘forest degradation’ and ‘primary forest degradation’ interchangeably, as well as ‘deforestation’ and ‘secondary forests deforestation’.

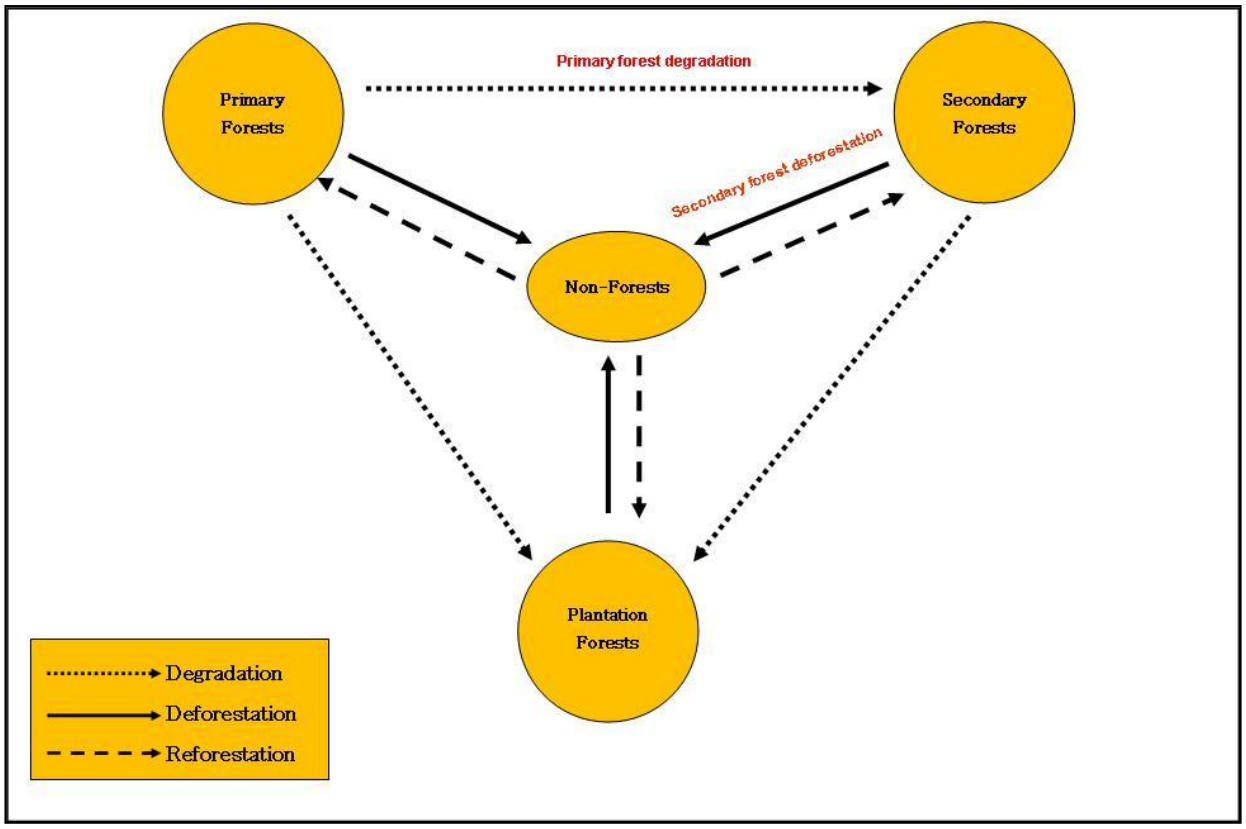


Figure III-5 The diagram of the land use change and focus of this study

Based on the above diagram, net forest loss can be determined by subtracting total reforestation from total deforestation over a period of time. Equation 3 defines net forest loss for this study.

Equation 3 Net forest loss

Net Forest Loss = - (Deforestation - Reforestation)

b) Forest degradation and deforestation rate

Vector data of land cover for 2000 and 2009 acquired from MoF were overlaid with thematic maps such as forest and district boundaries to analyse the land use change and quantify forest degradation and deforestation rates in the study areas. The quantification was carried out at

sub-district, before aggregating the figures into district and province level. Figure III-6 explains the flow of analysis to generate degraded areas of primary forests and deforestation in secondary forests. Equation 4 defines primary forests degradation, and Equation 5 defines secondary forests' deforestation rate.

Equation 4. Forest degradation rate

$$\text{Primary Forest Degradation Rate (FDR)} = \frac{\text{Degraded areas in primary forests}}{\text{Primary forests 2000}} \times 100$$

Equation 5. Deforestation rate

$$\text{Secondary Forests Deforestation Rate (DR)} = \frac{\text{Deforested areas in secondary forests}}{\text{Secondary Forests 2000}} \times 100$$

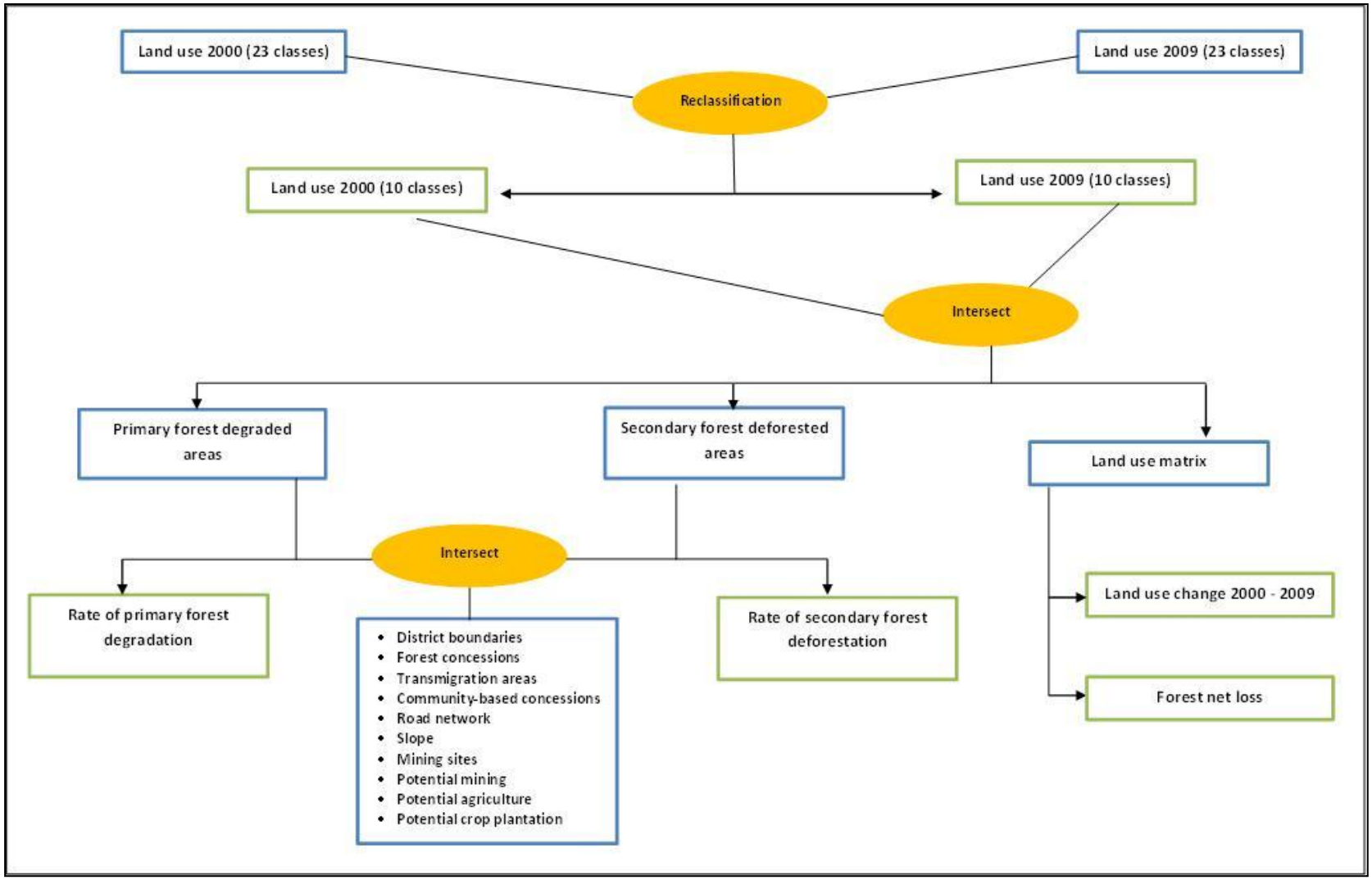


Figure III-6 Forest degradation and deforestation analysis

c) Forest degradation and deforestation maps

Degraded and deforested areas of the study sites were displayed on maps using GIS software. Maps were presented at provincial level (three maps) covering the period of 2000 - 2009.

5. Descriptive statistical analysis

a) Correlation coefficient

The study employs a descriptive statistical analysis to describe the correlation between dependent and independent variables. A linear model, Pearson's correlation coefficient was calculated using statistical package SPSS ver. 17.0, and scatter plot graphs were presented using statistical software R ver. 2.15.1. A number of variables were used to correlate the occurrence of degraded and deforested areas in South Kalimantan, East Kalimantan and SE Sulawesi. The variables including population density, poverty, potential agriculture, potential crop plantation, potential mining, mining sites, natural concessions, industrial plantation concessions, community-based plantations, transmigration areas, road network, and the degree of slope < 25%.

b) Variables

There are two different sources of variables: (1) Figures acquired from BPS, and (2) Figures calculated from spatial analysis in this study.

(1) Figures from BPS

As indicated in section D.2 and D.3 in this chapter, population density and the percentage of families in poverty were defined using Equation 1 and Equation 2 respectively. The figures represent variables 1 and 2.

(2) Figures from spatial analysis of this study

- **Forest degradation and deforestation**

Section D.4.b. in this chapter presents Equation 5 and Equation 6 to define forest degradation and the deforestation rate respectively. The figures represent dependent variables Y1 (deforestation) and Y2 (forest degradation).

- **Potential agriculture and crop plantation**

Maps of potential agriculture and crop plantation were acquired from the Indonesian Centre for Agricultural Land Resources Research and Development (Balai Besar Sumber Daya Lahan Pertanian/ BBSDL). BBSDL identifies land characteristics consisting of soil, climatic and topographic information to propose potential areas for agriculture and crop plantation. Further, land evaluation was carried out by BBSDL to define potential areas for agriculture and crop plantation. Figure III-7 shows the flowchart for land evaluation to generate potential agriculture and crop plantation (Ritung, Wahyunto, Agus, & Hidayat, 2007).

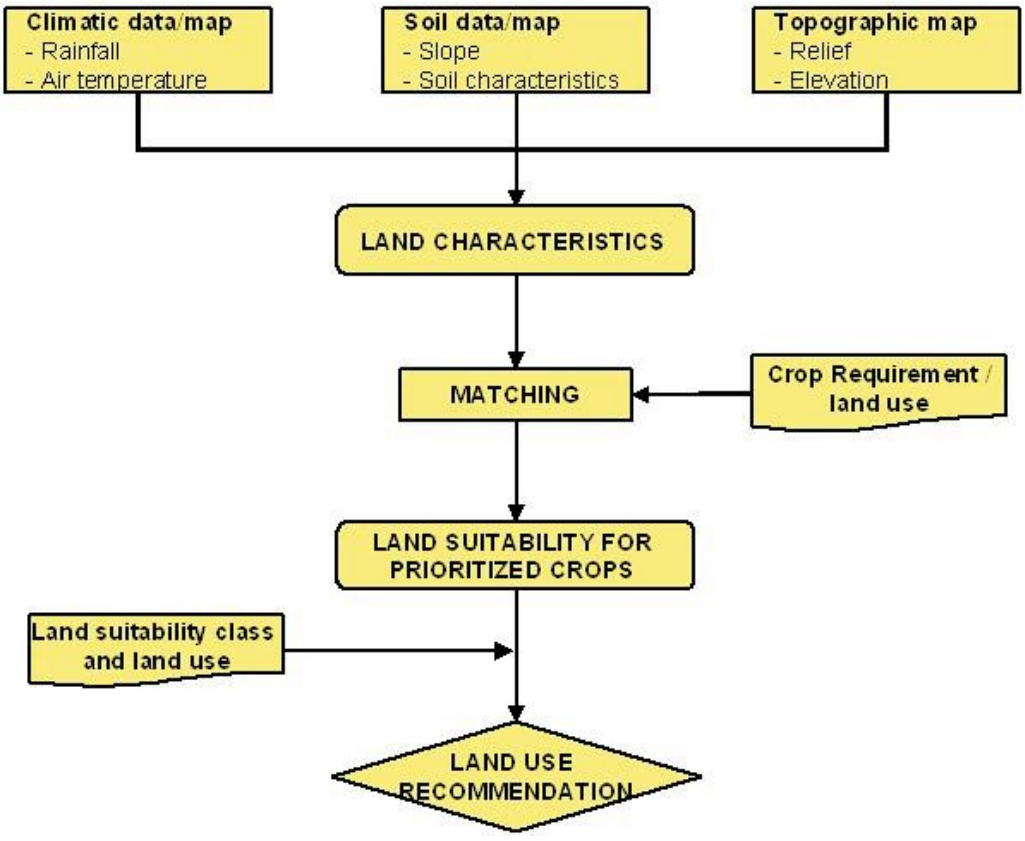


Figure III-7 Flowchart of the land evaluation process (Ritung et al., 2007)

Maps of potential agriculture and crop plantation cover the whole region of South Kalimantan, East Kalimantan and SE Sulawesi, but do not cover official forest areas (forest estate). The exclusion of forest estate areas implies a drawback for this study as forest degradation and deforestation occurs in both forest and non-forest areas depending on its land cover (forested or non-forested). These maps were then overlaid with land cover 2000 using GIS software. The areas of secondary forest containing potential agriculture and crop plantation were calculated. Further, the area (ha) and the proportion (%) of secondary forests for each sub-district containing potential areas were also calculated as the value for variable 3 (potential agriculture) and variable 4 (potential crop plantation).

- **Potential mining**

Potential coal mining covers the area of South Kalimantan and East Kalimantan, while potential nickel mining covers the area of SE Sulawesi. The potential areas cover both official forest areas (forest estate) and non-forest areas.

Maps of potential mining were overlaid with land cover 2000 using GIS software. The area of secondary forests containing potential mining was generated. Further, the area (ha) and the proportion (%) of secondary forests for each sub-district containing the potential areas was also calculated as the figures for variable 5 (potential mining).

- **Mining sites and forest concessions**

Shape files of mining sites, natural concessions and industrial concessions were overlaid with land cover 2000 using GIS software. The areas of primary and secondary forests within mining sites, natural concessions, and industrial concessions were generated. Further, the area (ha) and the proportion (%) of secondary forests and primary forests for each district located within mining sites, natural concessions, and industrial plantation forests were also calculated as the values for variables 6a and 6b (mining sites), variables 7a and 7b (natural concessions), and variables 8a and 8b (industrial plantation forests). Furthermore, variables 9a and 9b (forests concessions) were calculated by adding natural concessions and industrial plantation forests.

- **Community-based concessions and transmigration areas**

Deforestation occurs from 500 - 8000 metres from settlements (Legg and Scotland, 1998). The results indicate the highest proportion of deforested areas was located 1000 – 1500 metres from settlements and that little or no deforestation occurred further than 5500 m away from villages. For the purpose of the study, a 5000 m buffer was generated using ArcMap 10.0 around the community-based concessions and transmigration villages.

The areas of primary and secondary forests that overlap with the buffer areas of community-based concessions and transmigration areas were generated. Further, the area (ha) and the proportion (%) of secondary forests and primary forests for each sub-district located within the buffer areas were also calculated as the values for variables 10a and 10b (community-based concessions) and variable 11a and 11b (transmigration areas).

- **Road network**

Arunarwati and Weir (1998) suggested that most deforestation is located within one km of a road or a river. For the purpose of the study, a 1000 m buffer was generated in ArcMap 10.0 around road networks.

The areas of primary and secondary forests that overlap with the buffer areas were generated. Further, the area (ha) and the proportion (%) of secondary forests and primary forests for each district located within the buffer areas were also calculated as the values for variables 12a and 12b.

- **Slope < 25%**

Most deforestation in Western Jambi Province, Indonesia was located in the flat areas where the slope is less steep (Legg & Scotland, 1998). Land system shapefiles consist of geology, slope, rainfall and soil types of the whole region. Slope is classified into five different classes. In Indonesia, instead of using degree (^{o}) to represent slope, percentage of slope (%) is used to indicate the steepness of areas. Table III-6 presents slope classification.

Table III-6 Slope Classification

Slope Classification (MoF)		New Classification (This Study)	
Code	Classes	Classes	Code
A	<8%	< 25%	A
B	8% - 15%		
C	16% - 25%		
D	26% - 40%	> 26%	B
E	>40%		

This study uses slope of less than 25% as the threshold to represent the flat areas of the study sites. A new shapefile for this area with slope less than 25% was created. The new shapefile of slope was overlaid with land cover 2000 using GIS software. Further, the areas of primary and secondary forests located on flat areas with slope less than 25% were generated. The area (ha) and the proportion (%) of secondary forests and primary forests for each district located within these flat areas were also calculated as the values of variables 13a and 13b.

In summary, dependent and independent variables for this analysis are presented in Table III-7.

Table III-7 Dependent and independent variables

Dependent Variables	Explanatory Variables		
	Variables	Unit	ID
Secondary forest deforestation (Y1) **%** **(as calculated based on Equation 5)**	Population density 2009	Number of people per ha (as calculated based on Equation 1)	1
	Families in poverty 2009	% (Equation 2)	2
	Potential agriculture 2008	Area (ha) and % Secondary Forests of Potential Agriculture	3
	Potential crop plantation 2008	Area (ha) and % Secondary Forests of Potential Crop Plantation	4
	Potential mining 2009	Area (ha) and % Secondary Forests of Potential Mining	5
	Mining sites (updated in 2011)	Area (ha) and % Secondary Forest within Mining Sites	6a
	Natural concessions (a) (updated in 2011)	% Secondary Forests of Natural Concessions	7a
	Industrial plantation forests (b) (updated in 2011)	Area (ha) and % Secondary Forests of Industrial Plantation Forests	8a
	Forest concessions (a + b) (updated in 2011)	Area (ha) and % Secondary Forests of Forest Concessions	9a

	Community-based concessions (updated in 2011)	Area (ha) and % Secondary Forests of Community-based Concessions	10a
	Transmigration areas (updated in 2011)	Area (ha) and % Secondary Forests of Transmigration Areas	11a
	Road network (updated in 2011)	Area (ha) and % Secondary Forests within Road Network	12a
	Slope < 25% (updated in 2011)	Area (ha) and % Secondary Forests of Slope < 25%	13a
Primary forest degradation (Y2) **%** **(as calculated based on Equation 4)**	Population density 2009	Number of people per km2 (as calculated based on Equation 1)	1
	Families in poverty 2009	% (Equation 2)	2
	Mining sites (updated in 2011)	Area (ha) and % Primary Forest within Mining Sites	6b
	Natural concessions (a) (updated in 2011)	Area (ha) and % Primary Forests of Natural Concessions	7b
	Industrial plantation forests (b) (updated in 2011)	Area (ha) and % Primary Forests of Industrial Plantation Forests	8b
	Forest concessions (a + b) (updated in 2011)	Area (ha) and % Primary Forests of Forest Concessions	9b
	Community-based concessions (updated in 2011)	Area (ha) and % Primary Forests of Community-based Concessions	10b
	Transmigration areas (updated in 2011)	Area (ha) and % Primary Forests of Transmigration Areas	11b
	Road network (updated in 2011)	Area (ha) and % Primary Forests within Road Network	12b
	Slope < 25% (updated in 2011)	Area (ha) and % Primary Forests of Slope < 25%	13b

This study utilized population density and families in poverty in 2009 rather than 2000. After 2000, the Indonesian government implemented the Regional Autonomy Law (RAL) 22/1999 and its latest version 32/2004. Since then, hundreds of districts and thousands of sub-districts have been established. The study adopted the timeframe of 2000 and 2009 as some districts and sub-districts were not established in 2000. There were no data and information regarding population density and poverty available for those districts and sub-districts for the year 2000. The areas of those districts and sub-districts in 2000 can be obtained through GIS analyses as the old administrative boundaries (2000) and the new boundaries (2009) can be overlaid to calculate the area that existed in 2000 based on the boundaries in 2009. However the assumption made based on area could not be used as a proportion to calculate the population

density and poverty. Details of the administrative boundaries of the three selected provinces will be presented in Chapter 4.

IV. Study Sites

This study has concentrated on the three provinces of Indonesia: South Kalimantan, East Kalimantan and SE Sulawesi, which are located in Kalimantan (Borneo) and Sulawesi (Celebes) Islands; two islands among the five biggest islands of Indonesia. This chapter describes the geography, demography, economy and the land uses of each selected province. The background information is needed to help understand deforestation and forest degradation in these three provinces.

A. Geography

South Kalimantan is located on Kalimantan Island, the third largest island in the world after Greenland and New Guinea (Papua) (MacKinnon et al., 1996). Banjarmasin is the capital of South Kalimantan, although most of the provincial offices are currently located in Banjarbaru; 32 kilometres away. South Kalimantan is situated at 114^{o} 19' 13" – 116^{o} 33' 28" East Longitude and 1^{o} 21' 49" – 4^{o} 10' 14" South Latitude covering 7% of the total Kalimantan island. This province is the smallest province of Kalimantan Island and covers about 37,000 square kilometres.

East Kalimantan is also located on Kalimantan Island. Samarinda is the capital, although Balikpapan is the biggest city of this province. East Kalimantan is situated at 113^{o} 44' – 119^{o} 00' East Longitude and 4^{o} 24' – 2^{o} 25' South Latitude covering a terrestrial area of 198,442 square kilometres and a marine area of 10,217 square kilometres (BPS, 2012e). The northern part of this province shares a boundary with Malaysia's Sabah State (Eastern Malaysia), while the western part shares boundaries with West Kalimantan, Central Kalimantan, and Malaysia's Sarawak State (Eastern Malaysia) (Kadin, 2012). East Kalimantan is the largest province of Kalimantan Island and the second largest province of Indonesia (BPS, 2012e; MacKinnon, et al., 1996). The area of this province alone constitutes 10% of Indonesia's terrestrial area (MacKinnon et al., 1996), and the area is well-known for its rich reserves of timber, oil, coal, gas and other minerals (BPS, 2012e; Fatawi & Mori, 2000). In 1987, East Kalimantan alone

contributed 21% of Indonesia's export revenues from timber and mining resource, including oil and gas (MacKinnon et al., 1996).

SE Sulawesi is located on the east coast of the Sulawesi Island and covers a terrestrial area of 38,140 square kilometres, and a marine area of 110,000 square kilometres. The province is famous for its marine reserve areas such as Wakatobi National Park and is situated at 120^{o} 45' – 124^{o} 45' East Longitude and 2^{o} 45' – 6^{o} 15' South Latitude (BPS, 2012f). The capital is Kendari. SE Sulawesi shares boundaries with South Sulawesi and Central Sulawesi, although the Bone Strait separates most of the area between South Sulawesi and SE Sulawesi. A ferry across the Bone Strait links SE Sulawesi and South Sulawesi, and plays a major role in the transportation network between these two provinces.

The three provinces have tropical weather. The months of May – October are the dry season and November – April are the rainy season. The mean temperature in South Kalimantan ranges between approximately 21^{o}C – 35^{o}C and the air humidity between 62% – 94% all year (BPS, 2012d, 2012e, 2012f). In 2009, the highest rainfall occurred in January (384 mm) and the lowest was in September (21 mm). Like any other part of Indonesia, the climate of East Kalimantan is also typical of the equatorial tropics (Fatawi & Mori, 2000). It has only two different seasons; the dry season and the wet (rainy) season. The mean temperature ranges between 22^{o}C – 36^{o}C, while the level of air humidity ranges between 84% – 90% (BPS, 2009). The highest rainfall recorded in 2008 in Samarinda was 500 mm (in November) and the lowest was 51 mm in May 2008 (BPS, 2012e). In SE Sulawesi the mean temperature ranges between 19^{o}C – 34^{o}C, and the mean air humidity all year ranges between 72% – 88% (BPS, 2012f). The annual rainfall rate is not distributed evenly across this region and some areas are relatively dry. The region experiences annual rainfall of approximately 2000 mm/year (BPS, 2012f). In 2011 in Kolaka District, the highest rainfall was 230 mm (in March), while the lowest was in August with total rainfall of only 17 mm. The same year in Bau Bau District, the highest rainfall was 440 mm (in March), while the lowest was 12 mm in August (BPS, 2012f).

The soil types of Kalimantan and Sulawesi are quite different. The type of soil in South Kalimantan consists mostly of Red and Yellow Podsolic (55%), Alluvial soil (23%), and Organosol

(14%). In East Kalimantan, the most common type of soil is similar to that found in South Kalimantan; Red and Yellow Podsolic (Ultisols). This soil has very low nutrients and the top-soil is thin or even absent (Sugardiman, 2007). The other common soil groups are Reddish Brown Lateritics, Yellowish Brown Lateritic and Latosol (Sugardiman, 2007). The last group is also known as Oxisols (Sugardiman, 2007). In SE Sulawesi, on the contrary, soil type is dominated by Podsolic (60%) (BPS, 2012f).

The majority of South Kalimantan is flat with 75% of the area having slope of less than 15%. The altitude ranges between 0 – >1,000 m above sea level and 70% of the areas are located less than or equal to 100 m above sea level (BPS, 2012d). In East Kalimantan, the topographic conditions vary from gently undulating plain to rugged hills and mountainous areas (Sugardiman, 2007). This province includes 23% of flat land, while 29% lies in mountainous areas with a slope of more than 40% (BPS, 2012e). The altitude ranges between 0 – > 2,000 m above sea level with 63% of the areas less than 500 m above sea level. The highest peak on this province is Mount Mamtam (2,467 m) in Berau District (BPS, 2012e), where at vast number of primary forests are located. No volcanic mountains can be found in the area of Kalimantan (MacKinnon, 1996), unlike Java and Sulawesi where volcanic mountains and volcanic soils predominate (Whitten et al., 1988). Furthermore, the topographic condition of SE Sulawesi is mostly dominated by hills and mountainous areas. Forty nine percent of the total area consist of hilly or mountainous areas and only 26% of the land is considered low land and flat (BPS, 2012f). These flat lands are highly suitable for agricultural activities.

River systems in South Kalimantan and East Kalimantan play a pivotal role in the transportation network. In fact, the famous floating market in Indonesia is located in Banjarmasin, the capital of South Kalimantan, where local people from other districts have the opportunity to come to the capital to sell their local products. Major rivers in South Kalimantan such as Barito (890 km), Riam Kanan, and Riam Kiwa are among the rivers that pass through this province and mostly flow to the Makassar Strait or to the Java Sea (BPS, 2012d). Additionally the Mahakam River (650 km) in East Kalimantan, one of the mighty rivers on the island, is the major river network of this province. The river is used mostly by water-taxis transporting passengers and goods, pontoons transporting timber, coal and other natural resource products, and for transporting

floater logs through the river, from the highland forest areas to the lowland areas. Travel to inland areas is faster when river and land transport are combined.

Owing to the enactment of the Regional Autonomy Law in 1999, most areas in Indonesia from sub-district to provincial level have the opportunity to proliferate and establish new provinces, new districts and new sub-districts. In 2000, South Kalimantan only consisted of nine districts and two cities; by 2009, the area of the province was sub-divided into 11 districts and two cities. Two districts: Tanah Bumbu and Balangan were newly established districts. Figure I-1 presents the area of South Kalimantan and its administrative boundaries in 2000 and 2009. Kota Baru is the largest district and accounts for 25% of the total South Kalimantan area, while Banjarmasin city is the smallest with less than 1% of the total area (BPKM, 2012).

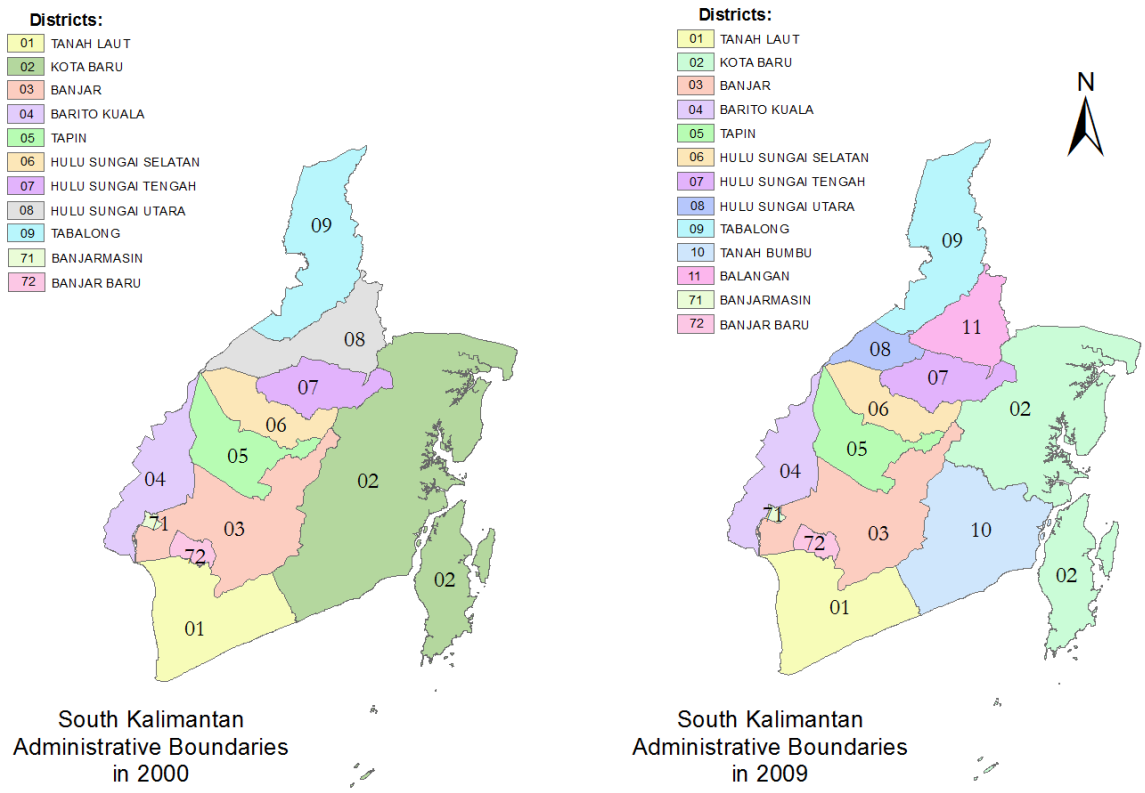


Figure IV-1 South Kalimantan administrative boundaries

In 2000, East Kalimantan consisted only eight districts and four cities. By 2009, the area of the province was sub-divided into 10 districts and four cities. Two districts: Penajam Paser Utara and Tana Tidung were newly established districts. Figure I-2 presents the area of East Kalimantan and its administrative boundaries in 2000 and 2009. Malinau District has the largest area; 17% of the total province, while Bontang City is the smallest (0.002%) (Kadin, 2011).

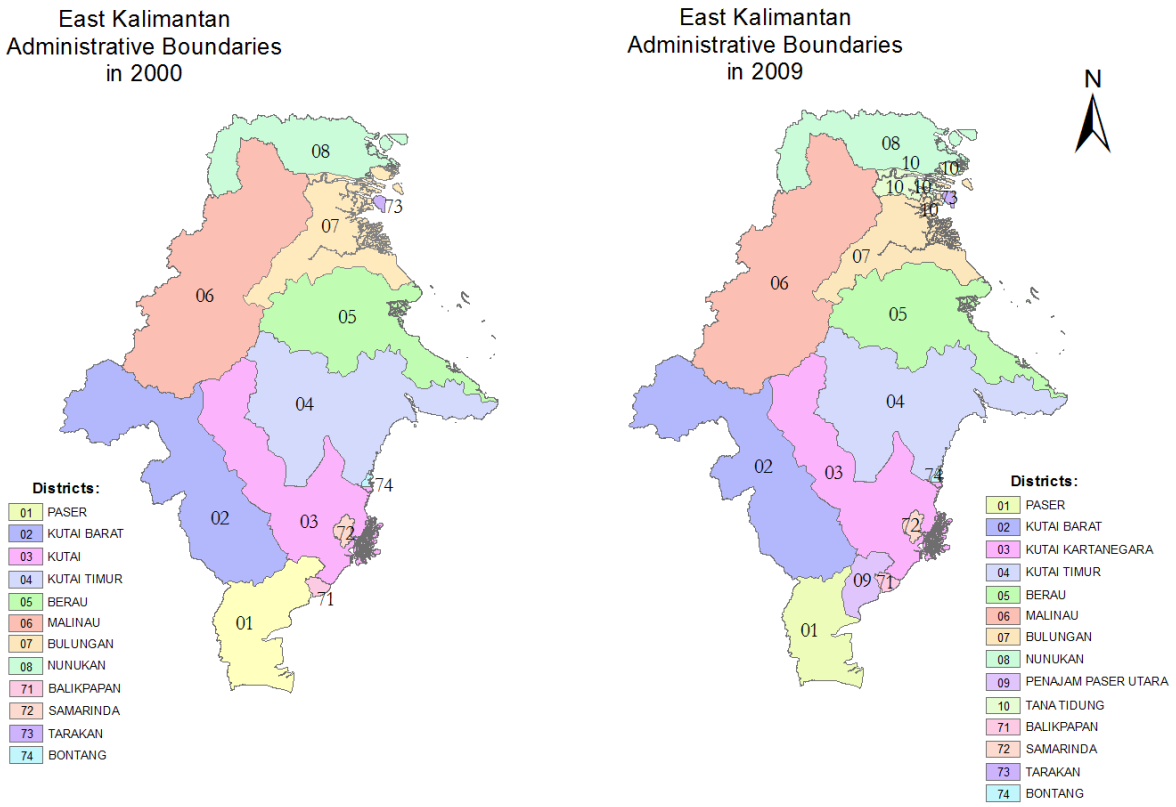


Figure IV-2 East Kalimantan administrative boundaries

In 2000, SE Sulawesi consisted only four districts and two cities. By 2009, the province was sub-divided into 10 districts and 2 cities. Figure I-3 shows SE Sulawesi administrative boundaries in 2000 and 2009. Kolaka is the largest district comprising 18% of the total areas, while Kendari City is the smallest (1%) (BKPM, 2012).

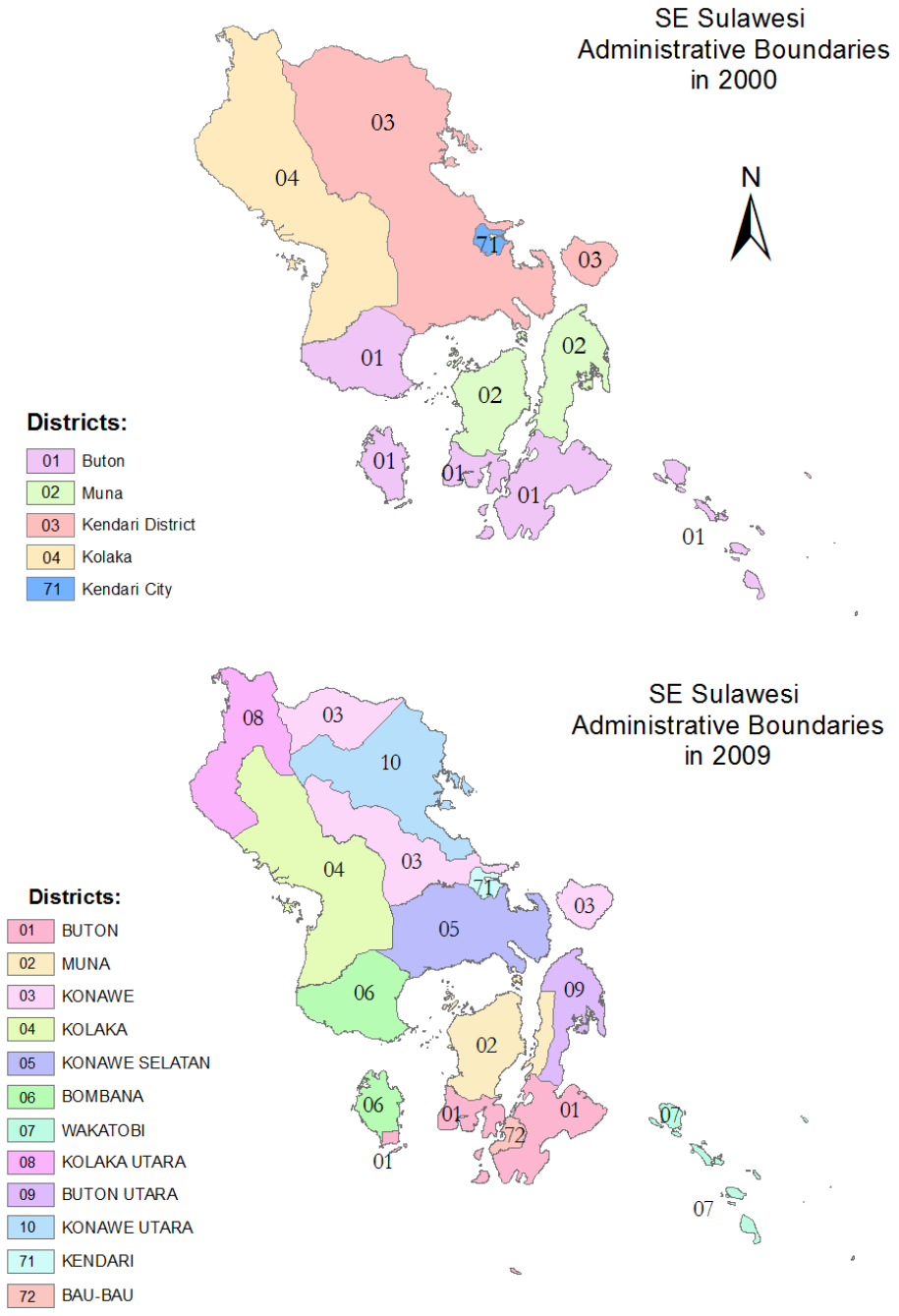


Figure IV-3 SE Sulawesi administrative boundaries

B. Demography

The local people in South Kalimantan are called Banjarese. Members of this ethnic group are the original inhabitants of the area, although other ethnic groups such as Dayak, Javanese, and Buginese also comprise the total population in South Kalimantan (BPS, 2012d). The introduction of other ethnic groups to this province was the result of transmigration programs introduced by the central government from the 1950s. People from Java Island were relocated to other areas including South Kalimantan to reduce overpopulation in Java where 60% of population in Indonesia is concentrated. Local people from East Kalimantan and Central Kalimantan (Dayak people) and people from South Sulawesi (Buginese) mostly migrate to South Kalimantan due to the employment opportunities in the timber and mining industries in this province. Another reason for this spontaneous transmigration is the adjacent geographical location of East Kalimantan, Central Kalimantan and South Sulawesi relative to South Kalimantan. The Makassar Strait, indeed, separates South Kalimantan and South Sulawesi with the widest part of the strait being 200 km separating Kalimantan and Sulawesi Islands (MacKinnon, 1996).

Unlike South Kalimantan, East Kalimantan's population is dominated by Dayak and Kutai, the indigenous inhabitants. Other ethnic groups such as Javanese, Buginese, Banjarese and Chinese also reside in this province and mostly live in the coastal areas, while Dayak people are mostly domiciled in the remote forest or mountainous areas. Buginese people dominate the coastal areas of East Kalimantan and have set up Buginese Villages (*Kampung Bugis*). The people are originally from South Sulawesi and are well-known as the traders and seafarers of Sulawesi's coastal areas (Whitten et al., 1988).

Migration in East Kalimantan occured for similar reasons as migration to South Kalimantan being mostly the result of government-supported transmigration and spontaneous transmigration related to the employment opportunities available and economic benefits offered by the local government. East Kalimantan is among the richest provinces in Indonesia; for instance, civil servants who work for the East Kalimantan provincial institutions receive higher incentives compared to other provinces of Indonesia. A high number of Bugis people from South Sulawesi migrated to East Kalimantan due to the geographical location and trading scheme between the two provinces. South Sulawesi is one of the close neighbours of East

Kalimantan, although these two provinces are separated by the Makassar Strait. The majority of inter-island export of South Sulawesi rice production is traded to East Kalimantan (Zain & Mahyuddin, 2009).

In SE Sulawesi, four main ethnic groups comprise the total population; Buton, Tolaki, Muna and Bugis, although Javanese and Chinese are among other ethnic groups residing in this province. The ethnic groups of Buton, Tolaki, and Muna are the native inhabitants of SE Sulawesi. Buginese are originally from South Sulawesi Province, even though this group is the second largest ethnic group in SE Sulawesi (BPS, 2012f).

The population in South Kalimantan, East Kalimantan and SE Sulawesi is unevenly distributed. In 2009, population density in these three provinces ranged from as few as 30 people/km^2 (South Kalimantan), 2 people/km^2 (East Kalimantan), and 9 people/km^2 (SE Sulawesi) in remote areas, to 8,712 people/km^2 in the capital of South Kalimantan, 1,070 people/km^2 in Balikpapan, the largest city in East Kalimantan, and 884 people/km^2 in Kendari, the capital of SE Sulawesi (BPS, 2010).

Between 2000 and 2009, the total population in South Kalimantan and East Kalimantan increased by 9% and 13% respectively (BPS 2000b, 2010). The total population of SE Sulawesi in 2000 was 1.75 million inhabitants and it grew 17% between 2000 and 2009 (BPS, 2000b, 2010). Table IV-1 presents population and population density by district in South Kalimantan, East Kalimantan and SE Sulawesi in 2009.

Table IV-1 Population and population density in 2009

Province	District	Population 2009	Population Density 2009 (people/km^2)
South Kalimantan	BARITO KUALA	275,143	92
	BANJARMASIN	627,245	8,712
	BANJAR BARU	171,496	462
	BANJAR	489,056	105
	HULU SUNGAI TENGAH	240,436	163
	HULU SUNGAI SELATAN	209,391	116
	HULU SUNGAI UTARA	206,430	231

	KOTA BARU	281,120	30
	TANAH LAUT	274,526	76
	TAPIN	154,646	57
	TABALONG	206,830	52
	TANAH BUMBU	302,137	60
	BALANGAN	102,702	55
East Kalimantan	KUTAI TIMUR	245,817	7
	BERAU	168,741	5
	KUTAI BARAT	171,953	5
	PASER	201,293	17
	BALIKPAPAN	538,525	1070
	TARAKAN	192,430	767
	KUTAI KARTANEGARA	626,286	23
	SAMARINDA	607,675	846
	BULUNGAN	100,600	8
	MALINAU	72,014	2
	NUNUKAN	132,542	9
	BONTANG	140,787	840
	PENAJAM PASER UTARA	137,165	41
	TANA TIDUNG	14,620	3
SE Sulawesi	KOLAKA	287,246	42
	KONAWE	233,080	35
	MUNA	248,461	84
	BUTON	279,546	112
	KENDARI	260,867	882
	BAU-BAU	130,862	592
	KONAWE SELATAN	244,046	54
	KOLAKA UTARA	118,386	35
	WAKATOBI	103,423	126
	BOMBANA	111,480	34
	KONAWE UTARA	46,635	9
	BUTON UTARA	49,186	26

(Source: BPS, 2010)

In 2005, the Indonesia National Statistic Agency (BPS), the National Development and Planning Agency (BAPPENAS), and the United Nations Population Fund (UNFPA) published a report, namely: the Indonesia Population Projection 2000 – 2025. The report indicates that, between 2000 and 2015, the population in South Kalimantan, East Kalimantan and SE Sulawesi will increase by 26%, 46% and 46% respectively. The report also highlights that between 2000 and 2025, the population in the three provinces studied will increase 43% (South Kalimantan), 79% (East Kalimantan) and 78% (SE Sulawesi) (BAPPENAS, 2005).

In 2004, the United Nation Development Programme (UNDP) published the Indonesia Human Development Report (UNDP, 2004). The report presents the 2002 Human Development Index (HDI) and the 2002 Human Poverty Index (HPI) for all provinces and districts of Indonesia. Indicators such as life expectancy, adult literacy rate, mean years of schooling, and adjusted real per capita expenditure were used to calculate the HDI (UNDP, 2004). The HPI, however, was determined by applying different indicators. This index was calculated using indicators such as people not expected to survive to age 40, adult illiteracy rate, population without access to clean water, population without access to health facilities, and under-nourished children under age five (UNDP, 2004).

In 2002, 41%, 37% and 41% of the population in South Kalimantan, East Kalimantan and SE Sulawesi respectively, had no access to safe water. In relation to health facilities, 27% (South Kalimantan), 22% (East Kalimantan) and 37% of the SE Sulawesi population had no access. Furthermore, 30% of children under age five were malnourished in South Kalimantan, 22% in East Kalimantan and 28.3% in SE Sulawesi (UNDP, 2004). Table IV-2 indicates the HDI and the HPI of South Kalimantan, East Kalimantan and SE Sulawesi in 2002.

Table IV-2 The Human Development Index (HDI) and the Human Poverty Index (HPI)

Province	HDI 2002		HPI 2002	
	Index**	**National Rank***	**Index*****	**National Rank***
South Kalimantan	64.3	23	25.5	19
East Kalimantan	70.0	4	19.1	5
SE Sulawesi	64.1	26	25.8	20

*out of 30 provinces **A high HDI index is the better ***A low HPI index is the better

(Source: UNDP, 2004)

C. Land Uses

1. Forest and Forestry

a) The official forest areas

Forest types in South Kalimantan and East Kalimantan include mangrove forest, peat swamp forest, freshwater swamp forest, forest on limestone, heath forest, and lowland dipterocarp forest (MacKinnon, et al., 1996). The last dominates the areas of East Kalimantan (Fatawi & Mori, 2000). South Kalimantan, however, has forests on ultrabasic soils that do not appear in East Kalimantan (MacKinnon et al., 1996). Similarly to South Kalimantan and East Kalimantan, forest types in SE Sulawesi include peat swamp forest, forest on ultrabasic soils and on limestone soils, riverine forest, and mangrove forest (Whitten, et al., 1988).

Despite these forest types, the areas are reclassified by MoF which assigns forest areas based on their function (as explained in Chapter 2). Table IV-3 and Table IV-4 indicate the official forest areas of South Kalimantan, East Kalimantan and SE Sulawesi by their function and by district level, and Table IV-5 presents the demarcation and the establishment of forest areas of these three provinces in 2011.

In South Kalimantan, the forest area covers 1.8 million ha or almost 50% of the total area. This forest area constitutes 60% of production forests (1.1 million ha), 9.5% of conservation forests, and 30% of protected forests (see Table IV-3). Conversion production forests, where legal land conversion can take place, accounted for 14% of the total forest area in South Kalimantan.

In East Kalimantan, based on its function, the forest area covers 74% (14.6 million ha) of the total area. Production forests, where all timber and non timber based licenscs can operate legally, covers 66% of East Kalimantan forest areas. Other official forest land use such as conservation forests and protected forests account for 15% and 19% respectively. There is no conversion production forest assigned in the East Kalimantan forest area (see Table IV-3).

Furthermore, in SE Sulawesi, the official forest area covers 2.6 million ha; 68% of its total terrestrial area. This province has 49% of production forests (1.3 million ha), 10% of conservation forests and 41% of protected forests. Conversion production forests account for 8% of the total forest areas of SE Sulawesi (see Table IV-3).

There is a long process towards the legal establishment of forest areas in Indonesia. As explained in Chapter 2 in this thesis, before establishing forest areas formally and legally, the MoF should review the allocation of forest areas through three stages; area assignment, demarcation boundary activities and forest areas establishment. By 2000, the Indonesian government through MoF had assigned forest areas nationally in each of the 33 provinces. Owing to the legal processes that need to be met, only small amounts of forest areas have been established legally (see Table IV-4) and the boundaries for large areas of these forests have not yet been demarcated and no forest boundaries signs are available on the ground. This encourages irresponsible people to carry out illegal activities within the forest areas, and even promotes accidental encroachment on the forest areas because of the absence of boundaries on the ground.

Table IV-3 Assigned forest areas based on their function

Province	Ministry of Forestry Decree No.	Production forests (ha)			Conservation forests (ha)	Protection forests (ha)	Total (ha)	Forest police personnel (2011)	Ratio personnel vs areas
		Permanent	Limited	Conversion					
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
South Kalimantan	79/Kpts-II/2001	688,884	155,268	265,638	175,585	554,139	1,839,494	213	1 : 8,500
East Kallimantan	453/Kpts-II/1999	5,121,688	4,612,965	-	2,165,198	2,751,702	14,651,553	554	1 : 26,000
SE Sulawesi	454/Kpts-II/1999	633,431	419,244	212,123	274,069	1,061,270	2,600,137	521	1 : 4,500

(source: MoF, 2012)

Table IV-4 Forest demarcation boundary and forest establishment until 2011

Province	Total assigned forest areas (ha)	Forest demarcation boundaries (ha)	Forest establishment (ha)
South Kalimantan	1,839,494	***	113,500**
East Kalimantan	14,651,553	210,347*	57,167**
SE Sulawesi	2,600,137	502,049	313,594

(Sources: MoF, 2012, DishutKaltim, 2010, DishutSultra, 2010)

*Data covers protected forests only **Data in 2011 only ***Data is not available

b) Forest concessions and timber-based production

Timber-based companies operated in Kalimantan forest areas before the 1970s. The foreign investment regulation was enacted in 1967, and since then commercial logging companies have operated extensively in timber rich areas such as Kalimantan, Sumatera and Papua. The forest area of Kalimantan is rich in biodiversity. For instance, at least 200 different tree species can be found within one hectare of lowland forest area of East Kalimantan (Fatawi & Mori, 2000) which attracts timber-based companies to invest in the forestry sector. The number of forest concessions in East Kalimantan is increasing overtime with; 13 units in 1969, 118 in 1996 and 124 in 2010 (Fatawi & Mori, 2000, MoF, 2011b). For the last 12 years, natural concessions in South Kalimantan have decreased both in units and areas, but the reverse is true for industrial plantation concessions. In 2000 there were five natural concession units covering 602,670 ha compared to four units in 2010 covering 243,241 ha (MoF, 2011b). The decrease in area is associated with the scarcity of primary forest in this province. The majority of natural concessions are allocated to the primary forests of production forests. Industrial plantation forests, however, have increased, with; six units in 2000 covering 332,260 ha and 14 units in 2010 covering 527,560 ha (MoF, 2000; 2011b).

SE Sulawesi, as one of the under-developed provinces in Indonesia, is mostly dependent on its agricultural products and mining commodities. Although the forestry sector is categorised under agriculture, this sector is not actually a significant contributor to the economic activities of this province when compared to crop plantation products. In 2001, there were three units of forest concessions, two units of natural concessions (416,000 ha) and one unit of industrial plantation concession (37,845 ha). All of these companies were shut down and the areas returned to MoF by 2005. The geographical conditions of the areas, particularly the hilly and mountainous areas, and limited infrastructure make it difficult for the forest concessions to survive. In 2006 two companies received a new licence from MoF to extract timber under the natural concession scheme. None of the industrial plantation companies operates in this province. Timber extracted from the two concessions is processed out of region, with no timber-processing plant with a capacity over 6,000 m^3 existing in SE Sulawesi. The closest is in South Sulawesi Province, in Luwu District, where three timber-processing factories (plywood, veneer and sawn timber industries) operate (MoF, 2011b).

Table IV-5 presents the total number of forest concessions in the three provinces: South Kalimantan, East Kalimantan and SE Sulawesi. A timber-rich province like East Kalimantan, where 70% of the area is still forested, has a high intensity of forest activities compared to the other two provinces, South Kalimantan and SE Sulawesi, which have 25% and 55% forested land respectively. Licence holders of natural concessions, industrial plantation forests, or community-based plantations are allowed to extract timber resources within the concession area. Restoration ecology concession holders can only harvest non-timber products and need to restore the ecological balance before timber extraction can be legally permitted.

Table IV-6 presents the potential areas for forestry development of these three provinces in 2008. Criteria such as the degree of slope, forest cover, stand density, areas, accessibility and land tenure were used to determine these potential areas. GIS analyses were applied to examine all the criteria and produce maps of potential areas. These potential areas were used by MoF in assessing proposals from forestry investors. Further ground checking will be needed to ensure the potential areas meet the forest land use policy and regulations. In East Kalimantan, although primary forests accounted for about 35% of the total area, less than 2% is feasible to be developed under natural forest concessions. Most of the primary areas were proposed to be allocated for REDD+ related programs.

MoF is responsible for monitoring and assessing the licence of all forest industries that have an installed capacity of over 6,000 m^3, while local government oversees the industries which have less than 6,000 m^3. There are 27 units of forest industry in South Kalimantan and 46 units in East Kalimantan (see Table IV-7). There are no forests industries with a capacity of over 6,000 m^3 operating in SE Sulawesi. Pulp and paper industries are not significant in Kalimantan and Sulawesi. Sumatera Island is the centre of pulp industries and between 1997 and 2001, the highest pulp productions were mostly in Riau and Jambi with some in North Sumatera and South Sumatera provinces (MoF, 2011b).

Table IV-5 Forest concessions until 2011

Province	Natural forest concessions		Industrial forest plantations		Community-based plantations		Restoration ecology concessions		Total	
	Unit	**Ha**	**Unit**	**Ha**	**Unit**	**Ha**	**Unit**	**Ha**	**Unit**	**Ha**
South Kalimantan	4	243,241	14	527,560	1	3,055	0	0	19	773,856
East Kalimantan	81	5,487,450	43	1,748,693	0	0	1	86,450	125	7,322,593
SE Sulawesi	2	89,590	0	0	2	10,155	0	0	4	99,745

Source: Ministry of Forestry (MoF, 2011b)

Table IV-6 Potential development for forest concessions

Province	Potential environmental service sites/carbon stocks (ha)	Potential natural forest concessions (ha)	Potential industrial forest plantations (ha)	Potential community-based plantations (ha)	Potential protected sites (ha)	Potential restoration ecology concessions (ha)	Total (ha)
South Kalimantan	0	14,283	251,078	49,709	711	70,787	386,568
East Kalimantan	1,039,685	310,943	594,075	172,224	37,653	344,865	2,499,444
SE Sulawesi	106,805	148,390	292,043	31,824	0	177,948	756,915

Source: Ministry of Forestry (MoF, 2009a)

Table IV-7 Forest industries in the three provinces studied

Province	Forest industries with yearly capacity over 6,000 m^3/year*					
	Unit	Plywood	Sawn Timber	Veneer	Wood Chips	LVL	Wood Pellet
South Kalimantan	27	1,523,095	347,600	264,000	1,850,200	135,000	0
East Kalimantan	46	2,101,827	948,076	280,645	7,464,365	0	0
SE Sulawesi	0	0	0	0	0	0	0

*Data until November 2011 (Source: MoF, 2011b)

Table IV-8 Timber based productions from 1997 and 2011

Province	Log production (m^3)									
	1997	1998	1999	2000	2001	2006	2007	2008	2009	2010
South Kalimantan	439,260	351,108	298,048	236,198	52,524	*	*	*	*	502,417
East Kalimantan	6,600,653	3,885,875	1,402,650	3,359,019	970,054	*	*	*	*	5,377,130
SE Sulawesi	194,555	189,525	85,186	5,425	0	*	*	*	*	*
Province	**Sawn timber production (m^3)**									
	1997	**1998**	**1999**	**2000**	**2001**	**2006**	**2007**	**2008**	**2009**	**2010**
South Kalimantan	242,015	324,118	132,026	104,193	37,491	111,151	68,957	91,518	91,768	102,270
East Kalimantan	116,770	165,917	89,395	346,885	129,298	6,740	8,586	5,724	8,801	10,127
SE Sulawesi	2,658	4,926	748,056	1,301	5,797	12,012	0	0	0	0
Province	**Plywood production (m^3)**									
	1997	**1998**	**1999**	**2000**	**2001**	**2006**	**2007**	**2008**	**2009**	**2010**
South Kalimantan	1,085,003	1,496,518	1,004,049	1,040,528	151,769	467,206	449,702	395,195	341,902	388,412
East Kalimantan	986,103	1,324,820	1,053,531	1,005,466	756,301	811,816	786,644	668,056	613,911	610,006
SE Sulawesi	0	0	0	0	0	0	0	0	0	0
Province	**Veneer production (m^3)**									
	1997	**1998**	**1999**	**2000**	**2001**	**2006**	**2007**	**2008**	**2009**	**2010**
South Kalimantan	0	52,016	12,730	1,790	397	24,259	57,961	34,631	28,167	5,114
East Kalimantan	23,192	54,293	69,434	*	*	4,365	6,321	5,467	1,225	22,952
SE Sulawesi	0	0	0	0	0	0	0	0	0	0

*Data is not available (Sources: MoF, 2001, 2011b).

Table IV-8 presents timber-based production in the three provinces from 1997 – 2011. Generally the timber-based production decreased. Plywood, veneer, log and sawn timber production has become less in quantity because the forest resources in South Kalimantan, East Kalimantan and SE Sulawesi are decreasing. The high level of illegal activities and the improper monitoring system are reflecting the inadequate and incomplete data presented in Table IV-8.

c) Threats to forest resources

Threats to the forest resources of these three provinces studied have decreased the economic benefits from the sector. Deforestation and forest degradation have put pressure on forest areas and led to habitat loss of some endemic species. Other problems such as overexploitation, poor harvesting methods, limited regeneration, lack of reforestation technology, and losses to shifting cultivation and to forest fires have also contributed to the Kalimantan and Sulawesi forest losses (MacKinnon et al., 1996; Whitten et al., 1988). Kalimantan and Sulawesi are among the areas of the world which have lost their lowland forest areas at an alarming rate (Holmes, 2000; MacKinnon et al., 1996).

A vast area of forest loss is also related to the low number of forestry police personnel compared to the huge amount of forest area of the country. In 2001, forestry police personnel in South Kalimantan consisted of 201 officers, increasing to 213 officers in 2011 to safeguard the 1.8 million ha of forest areas of this province (MoF, 2001; 2011b). In East Kalimantan forestry police personnel consisted of 531 officers in 2001, increasing to 554 officers in 2011 to safeguard the 14.6 million ha of forest areas of this province (MoF, 2001; 2011b). Furthermore, in SE Sulawesi there were 299 officers in 2001, increasing to 521 officers in 2011 to safeguard the 2.3 million ha of forest areas of this province (MoF, 2001, 2011b). This means the ratio is 1: 8,500 ha in South Kalimantan, 1: 26,000 ha in East Kalimantan and 1: 4,500 ha in SE Sulawesi.

Forest fires in 1982/1983 and 1997/1998 also contributed to a high rate of forest loss in the forest areas of Kalimantan. These forest fires severely damaged the forest ecosystem in the lowland dipterocarp forest, especially in East Kalimantan (Fatawi & Mori, 2000; Sugardiman, 2007).

Table IV-9 The extent of forest fires between 1983 and 1998

Year	East Kalimantan (Ha)	Indonesia (Ha)	Year	East Kalimantan (Ha)	Indonesia (Ha)
1983	-	-	**1991**	4,693	118,881
1984	0	15,079	**1992**	3,526	14,531
1985	0	42,570	**1993**	350	40,897
1986	0	22,038	**1994**	3,963	161,798
1987	233	49,323	**1995**	34	6,705
1988	0	17,661	**1996**	301	10,356
1989	0	15,885	**1997**	21,483	263,991
1990	1,000	25,573	**1998**	519,761[a]	-

[a]Data until mid-1998 (Source: Fatawi & Mori, 2000)

Table IV-9 indicates how much forest fires severely affected the existence of forest areas in Indonesia, particularly in East Kalimantan. However, there was no record of one of the largest forest fires in Indonesia which occurred in 1982/1983. During this period, the estimate of forest areas affected by the fire and drought was 3.6 million ha in East Kalimantan alone (MacKinnon et al., 1996; Fatawi & Mori, 2000). In contrast to South Kalimantan and East Kalimantan where forest fire has severely affected forest areas, the incidence of forest fires in SE Sulawesi is less frequent. Table IV-10 presents forest fires in the three provinces between 2007 and 2010.

Table IV-10 The extent of forest fires from 1997 to 2011

Province	The extent of forest fires (Ha)							
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
South Kalimantan	25,961	26	-	2	8	-	-	-
East Kalimantan	21,483	508,732	-	-	33	33	6	302
SE Sulawesi	4,699	-	162	-	-	141	-	-
Province	**The extent of forest fires (Ha)**							
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	
South Kalimantan	-	2,991	2,208	2,108	2,512	206	-	
East Kalimantan	102	-	-	-	28,533	0	149	
SE Sulawesi	-	-	-	68	126	7,233	86	

(MoF, 2001, 2008b, 2011b; Pemerintah Provinsi Kalimantan Selatan, 2010; Pemerintah Provinsi Kalimantan Timur, 2010; Pemerintah Provinsi Sulawesi Tenggara, 2011)

2. Non-forests

As in many other parts of Indonesia, agricultural expansion is also a major cause of forest loss in Kalimantan and Sulawesi. Land use for non-forestry activities in South Kalimantan, East Kalimantan and SE Sulawesi has been increasing and the same holds true for agricultural production. Table IV-12 – Table IV-14 present land use and production from non-forestry activities such as agricultural land and mining sites of the three provinces studied. Included in agricultural activities are paddy field, crop plantation and food crops.

In all three provinces, agricultural land use increased between 2000 and 2009. Inadequate data, however, hampered the ability to quantify how much total agricultural land increased between 2000 and 2009, especially by each commodity for these particular periods of time. For instance, to quantify the increase in oil palm plantations in the three provinces studied, especially at the district level, is a difficult task. Non forestry land uses in South Kalimantan, East Kalimantan and SE Sulawesi are presented in Table IV-12, Table IV-13, and Table IV-14 respectively. Table IV-12 specifically presents how much paddy fields and rubber plantations in South Kalimantan increased between 2000 and 2009; Table IV-13 shows how much oil palm plantations, rubber plantations and cacao plantations developed in the area of East Kalimantan between 2000 and 2009 and Table IV-14 presents how much paddy fields and cacao plantations increased between 2000 and 2009 in SE Sulawesi.

Table IV-11 Non forestry land uses in South Kalimantan

South Kalimantan District	Paddy Fields 2000 (Ha)	Paddy Production 2000 (Ton)	Rubber Plantation 2000 (Ha)	Rubber Production 2000 (Ha)	Coal Mining 2000 (Ha)	Paddy Fields 2009 (Ha)	Paddy Production 2009 (ton)	Oil Palm Plantation 2009 (Ha)	Palm Oil Production 2009 (Ton)	Rubber Plantation 2009 (Ha)	Rubber Production 2009 (Ton)
	1	2	3	4	5	6	7	8	9	10	11
Tanah Laut	33,875	107,188	5,210	752	43,977	2,580	6,697	7,237	13,781	10,559	5,751
Kota Baru**	45,465	193,990	1,520	5,986	201,258	26,531	97,347	17,953	107,107	4,730	3,625
Banjar	62,636	240,342	9,234	16,681	27,998	171,096	537,597	110,080	1,207	11,078	122,707
Barito Kuala	88,489	*	68	*	0	95,320	317,605	368	*	1,679	138
Tapin	45,510	173,984	6,849	8,847	22,522	64,080	258,016	150	*	17,215	10,596
Hulu Sungai Selatan	37,438	226,108	1,129	5,691	1,228	46,009	211,153	1,917	2,051	12,786	*
Hulu Sungai Tengah	29,231	*	*	*	2,141	45,588	208,957	*	*	13,762	11,600
Hulu Sungai Utara**	39,100	116,302	*	*	7,057	29,528	161,340	6	*	887	122
Tabalong	11,819	*	68,138	*	46,537	27,111	123,694	815	*	53,850	34,427
Banjarmasin	1,934	5,878	*	*	0	1,813	5,638	*	*	*	*
Banjarbaru	53,674	65,631	1,814		4,409	3,708	13,117	105	*	577	2,678
Tanah Bumbu**	-	-	-	-	-	24,217	91,479	48,709	527,098	15,595	10,332
Balangan**	-	-	-	-	-	22,569	92,095	355	564	33,795	27,957
T O T A L	**449,171**	**1,129,421**	**93,962**	**37,957**	**357,127**	**560,150**	**2,124,735**	**187,695**	**651,808**	**176,513**	**229,933**

*Data is not available **District has not established yet in 2000 (Sources: BPS, 2000, 2012d)

Table IV-12 Non forestry land uses in East Kalimantan

East Kalimantan District	Paddy Fields 2000 (Ha)	Paddy Production 2000 (Ton)	Rubber Plantation 2000 (Ha)	Rubber Prod. 2000 (Ha)	Cacao Plantation 2000 (Ha)	Cocoa Prod. 2000 (Ha)	Oil Palm Plantation 2000 (Ha)	Palm Oil Prod. 2000 (Ton)	Coal Mining 2000 (Ha)	Paddy Fields 2009 (Ha)	Paddy Prod. 2009 (ton)	Oil Palm Plantation 2009 (Ha)	Palm Oil Prod. 2009 (Ton)	Rubber Plantation 2009 (Ha)	Rubber Prod. 2009 (Ton)	Cacao Plantation 2009 (Ha)	Coal Mining Prod. 2009 (Ton)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Paser	24,279	69,288	14,593	7,802	1,574	101	58,439	342,841	171,111	13,025	44,319	87,318	706,955	8,297	7,263	878	*
Kutai Barat	23,973	*	*	*	*	*	*	*	179,932	11,169	33,018	150	43	34,209	31,730	1,106	10,378,941
Kutai Kartanegara	53,987	*	*	*	*	*	*	*	227,863	42,743	206,595	110,376	252,534	12,206	5,293	2,112	20,883,783
KutaiTimur	4,161	11,561	1,185	172	6,100	2,707	*	*	181,375	22,035	31,400	170,301	947,265	3,518	238	7,382	38,154,491"
Berau	8,420	21,519	754	-	*	*	*	*	35,936	10,324	29,607	35,582	*	1,115	65	3,250	14,510,177
Malinau	7,503	15,933	*	*	2,236	*	*	*	39,587	10,720	26,742	*	*	531	0	3,784	906,638
Bulungan	10,268	32,207	*	*	*	*	*	*	47,388	14,994	51,072	1,125	*	124	*	976	1,661,679
Nunukan	9,224	60,697	*	*	7,107	*	*	*	5,436	10,667	43,496	59,262	58,439	-	-	13,034	2,538,347
PenajamPaser Utara**	-	-	-	-	-	-	-	-	0	12,612	62,514	75,084	255,582	15,659	4,054	276	*
TanaTidung**	-	-	-	-	-	-	-	-	0	1,670	2,687	-	-	-	-	-	-
Balikpapan	30	159	1,530	2,750	*	*	*	*	896	263	886	-	-	3,812	1,611	33	*
Samarinda	6,889	*	*	*	*	*	*	*	24,096	4,843	25,866	-	-	825	*	701	-
Tarakan	0	*	*	*	*	*	*	*	1,976	49	104	-	-	-	-	-	-
Bontang	80	85	*	*	*	*	*	*	338	139	4,448	-	-	-	-	-	-
T O T A L	**148,814**	**211,449**	**18,062**	**10,724**	**17,017**	**2,808**	**58,439**	**342,841**	**916,422**	**155,253**	**562,755**	**539,198**	**2,220,818**	**80,298**	**50,254**	**33,532**	**89,034,056**

*Data is not available **District was not yet established in 2000 "Data presents PT. Kaltim Prima Coal production (Sources: BPS, 2000, 2012e)

Table IV-13 Non forestry land uses in SE Sulawesi

SE Sulawesi District	Paddy Fields 2000 (Ha)	Paddy Production 2000 (Ton)	Cacao Plantation 2000 (Ha)	Cocoa Production 2000 (Ha)	Nickel Mining 2000 (Ha)	Nickel Production 2000 (Ton	Nickel Mining 2009 (Ha)	Nickel Production 2009 (Ton)	Paddy Fields 2009 (Ha)	Paddy Production 2009 (ton)	Cacao Plantation 2009 (Ha)	Cocoa Production 2009 (Ton)	Cashew Plantation 2009 (Ha)	Cashew Production 2009 (Ton)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Buton	9,731	*	*	*	9,992	*	3,243	90,000	248,871	11,963	3,082	2,637	22,524	24,650
Muna	4,841	*	6,992	2,631	*	*	*	*	5,310	14,612	6,161	2,594	30,948	2,641
Konawe**	-	-	-	-	-	-	*	*	34,066	146,677	15,785	6,188	11,462	4,194
Kolaka	17,294	18,778	74,834	*	50,336	*	*	1,577,602	21,984	856,276	78,250	49,449	3,927	1,425
Konawe Selatan**	-	-	-	-	-	-	*	*	20,535	93,388	18,179	8,268	17,930	7,288
Bombana**	-	-	-	-	-	-	*	*	10,648	17,252	9,687	6,152	18,534	11,734
Wakatobi**	-	-	-	-	-	-	*	*	-	-	17	11	1,408	51
Kolaka Utara**	-	-	-	-	-	-	*	*	1,908	8,376	76,436	73,899	244	78
Buton Utara**	-	-	-	-	-	-	*	*	3,808	9,133	3,264	852	7,044	3,005
Konawe Utara**	-	-	-	-	-	-	*	160,570	16,627	8,871	4,256	4,237	4,784	2,257
Kendari	722	*	839	*	*	*	*	*	494	1,756	844	394	1,345	510
Bau-Bau**	514	*	*	*	-	-	*	*	2,602	10,274	206	143	661	112
T O T A L	**32,380**	**18,778**	**82,665**	**2,631**	**60,328**	**-**	**3,243**	**1,667,602**	**366,853**	**1,178,578**	**216,167**	**154,824**	**120,811**	**57,945**

*Data is not available **District has not established yet in 2000 (Sources: BPS, 2000, 2012f)

D. Economy

The whole island of Kalimantan has soils which are nutrient poor and this creates a huge constraint for agricultural activities (MacKinnon, 1996). Twenty one percent of South Kalimantan's economic gain in 2010 was from agricultural related products, compared to only 6% in East Kalimantan (BPS, 2012d, 2012e). Included in the agricultural related products are food and crop plantation, fishery and forestry products (BPS, 2012e). In SE Sulawesi, as in many other areas of Sulawesi, agriculture has been the economic backbone. In 2009, 35% of the regional Gross Domestic Product (GDP) of this province was from the agricultural sector, while the mining sector contributed only 4%. In South Kalimantan and East Kalimantan, the mining sector contributed 18% and 33% to the 2002 GDP respectively and grew to 24% (South Kalimantan) and 51% (East Kalimantan) in 2011 (BPS, 2012d, 2012e, 2012f; Kadin, 2012).

In South Kalimantan, the agricultural and mining sectors contributed 21% and 24% respectively to the 2011 regional GDP. In East Kalimantan, agriculture contributed only 5% to the 2008 regional GDP and increased to 6% in 2011. The mining sector is the most important contributor to the regional GDP of this province and in 2008, it contributed 46% to the regional GDP and this increased to 51% in 2011 (BPS, 2012e). Kutai Kartanegara contributes the largest portion to the regional GDP of this province (34%), and is followed by Bontang (17%), Kutai Timur and Balikpapan (13%) (BPS, 2012e). Furthermore, in SE Sulawesi, the portion that agriculture contributes to the regional GDP is decreasing; from 40% in 2006 it dropped to 33% in 2010, while the contribution from trade, hotels and restaurants to the GDP has been increasing from 10% in 2006 to 20% in 2010 (BPS, 2012f).

Table IV-15 presents the volume and value of exports from major seaports in the three provinces studied in 2007 and 2010. Generally, both the volume and value of exports from the major seaport in South Kalimantan, East Kalimantan, and SE Sulawesi have increased. A major contribution to the increasing trend came from the mining sector (BPS, 2010).

Table IV-14 Volume of exports and value of exports from major seaports of the three provinces

Province	Major Port	Volume of Exports (Net weight: thousand ton)		Value of Exports (FoBmillion US$)	
		2007	**2011**	**2007**	**2011**
South Kalimantan	Banjarmasin	42,378	61,321	1,566	4,899
	Kotabaru	35,506	63,793	1,182	4,717
East Kalimantan	Balikpapan	14,145	15,453	2,241	3,274
	Samarinda	25,676	80,949	1,158	6,245
	TanjungSantan	2,967	1,930	1,635	1,567
	TanjungSangatta	36,819	39,469	1,304	3,830
	Bontang	28,412	40,710	9,006	17,079
	Senipah	931	1,460	493	1,032
SE Sulawesi	Kolaka	3	1,308	5	40
	Pomalaa	1,431	11,224	400	730
	Kendari	2,406*	16,254	195*	520

*2009 (Source: BPS, 2012d, 2012e, 2012f)

Ninety eight percent of export volume in South Kalimantan is from the mining sector, particularly from coal commodities (BPS, 2012d). The volume of palm oil exports of South Kalimantan contributed only 0.8%, while timber-related products dropped from 0.3% in 2010 to only 0.2% of the total exports in 2011 (BPS, 2012d). In East Kalimantan, 96% of export volume is from the mining sector, 10% from oil and gas commodities and 86% from coal exports (BPS, 2012). Crude palm oil only contributes 0.2% of the total volume of exports in this province (BPS, 2012e).

E. Summary of the chapter

The three provinces studied: South Kalimantan, East Kalimantan, and SE Sulawesi, are rich in natural resources and have high biodiversity values, with East Kalimantan being the richest. The land and especially the forest resources have been exploited generally for the sake of economic benefits. In all three provinces, sectors such as mining, forestry and agriculture have been the

backbone sustaining the economic activity of the local people who are still highly dependent on the extraction of natural resources.

V. Results

A. Descriptive results

1. Human density & poverty

This section provides data on human density and the percentage of poverty in the three selected provinces. These variables were used to relate with the rates of deforestation and forest degradation of the provinces. Human density and the percentage of poverty were calculated based on Equation 1 and Equation 2 as explained in Chapter 3. Table V-1 indicates human density and poverty in 2009 for all three provinces.

Table V-1 Population density and poverty

Province	Area (Ha)*	Population (ppl)*	Population Density 2009 (ppl/kilometre^2)
South Kalimantan	3,892,496	3,541,158	91
East Kalimantan	22,010,406	3,350,448	15
SE Sulawesi	3,852,910	2,113,218	55
Province	Poverty Households 2009**	Households 2009**	Poverty 2009 (%)
South Kalimantan	325,180	941,232	35
East Kalimantan	243,606	768,862	32
SE Sulawesi	322,209	516,230	62

Source: *BPS, 2009 **BKKBN, 2009

In 2009, the three provinces studied had a different population density. Table V-1 shows that South Kalimantan is the densest among the three provinces, followed by SE Sulawesi with 55 people per square kilometre. East Kalimantan, however, is the sparsest and in 2009, the province only had 15 inhabitants per square kilometre compared to 91 inhabitants per square kilometre in South Kalimantan (see Table V-1).

In East Kalimantan, the richest province in Indonesia (in terms of timber resources and mining commodities), the percentage of poverty is the lowest. Meanwhile, SE Sulawesi is the poorest.

In 2009, poverty rate in the province was 62%, compared to 35% in South Kalimantan and 32% in East Kalimantan (see Table V-1).

2. Land Use Change: An Overview between 1990 and 2009

Between 1990 and 2009, substantial land conversion occurred in the three selected provinces. Detailed land conversion between 1990 and 2000 is presented in Table V-2, Table V-4 and Table V-6. Correspondingly, Table V-3, Table V-5 and Table V-7 present the land conversion for the subsequent period of 2000 to 2009.

Specifically, Table V-2, Table V-4, and Table V-5 present the allocation of the land in 1990 in field rows, while the allocation of the land in 2000 is presented in field columns. Table V-3, Table V-5, and Table V-7 give land use in 2000 presented in field rows and land use in 2009 is presented in field columns.

Table V-2 Detailed land use changes in South Kalimantan between 1990 and 2000

South Kalimantan	1 Primary Forest	2 Secondary Forest	3 Plantation Forest	4 Bushland	5 Agriculture	6 Paddy Field	7 Mining Areas	8 Crop Plantation	9 Settlement	Others	Grand Total 1990
1 Primary Forest	63,098	479,649	1,506	90,334	6,558		3,492	2,588		2,304	649,529
2 Secondary Forest		383,441	208	227,578	397,972	1,548	21,272	14,521	1,807	77,026	1,125,373
3 Plantation Forest			109,216		374				12		109,602
4 Bushland			199	204,661	31,829	13,780	12,191	8,499	1,159	260	272,578
5 Agriculture					821,767		61		39		821,867
6 Paddy Field					8,514	192,398					200,912
7 Mining Areas				138	1,197	11,684	23,750	138	13	230	37,150
8 Crop Plantation							1,373	161,771			163,144
9 Settlement			5		604		479		37,712		38,800
Others			5,573	20,890	79,307	5,954	13,177	20,641	2,095	136,517	284,154
Grand Total 2000	**63,098**	**863,089**	**116,708**	**543,601**	**1,348,123**	**225,364**	**75,793**	**208,159**	**43,837**	**216,337**	**3,703,111**

Table V-3 Detailed land use changes in South Kalimantan between 2000 and 2009

South Kalimantan	1 Primary Forest	2 Secondary Forest	3 Plantation Forest	4 Bushland	5 Agriculture	6 Paddy Field	7 Mining Areas	8 Crop Plantation	9 Settlement	Others	Grand Total 2000
1 Primary Forest	61,249	1,269		2	101					477	63,098
2 Secondary Forest		730,571	6,850	64,535	18,001		5,372	8,615		29,146	863,089
3 Plantation Forest			101,999	7,729	959		5,046	975			116,708
4 Bushland		321	7,443	432,260	23,262		31,534	48,751	8	21	543,601
5 Agriculture		24	1,140	817	1,230,170	58,104	39,853	17,050	946	20	1,348,123
6 Paddy Field					1,562	223,710	93				225,364
7 Mining Areas			1,270	453	4,672	760	53,570	15,050		18	75,793
8 Crop Plantation				2,200	936		3,236	201,577	210		208,159
9 Settlement			3	28	1,979		27	244	40,556		42,837
Others			566	86	31,516	46	20,460	3,565	29	160,068	216,337
Grand Total 2009	**61,249**	**732,185**	**119,271**	**508,110**	**1,313,158**	**282,620**	**159,191**	**295,828**	**41,749**	**189,750**	**3,703,110**

Table V-4 Detailed land use changes in East Kalimantan between 1990 and 2000

East Kalimantan	1 Primary Forest	2 Secondary Forest	3 Plantation Forest	4 Bushland	5 Agriculture	6 Paddy Field	7 Mining Areas	8 Crop Plantation	9 Settlement	Others	Grand Total 1990
1 Primary Forest	7,453,993	646,987	182	12,755	16,012		1,569	477	1,025	32,582	8,165,582
2 Secondary Forest		6,067,805	6,599	733,386	12,800		5,010	19,189	717	16,778	6,862,284
3 Plantation Forest			224,527	3,325				1		2	227,855
4 Bushland			840	2,043,525	22,960		2,148		822	959	2,071,254
5 Agriculture				62,036	546,784			1	102	1,083	610,006
6 Paddy Field						6,958				266	7,224
7 Mining Areas			95	380	29		228,560	12	644	248	229,968
8 Crop Plantation			2,061	49,735	2,997			243,381		4	298,178
9 Settlement				72	768			62	82,054	384	83,340
Others				5,333	182	29	3,632	12,122	46	986,933	1,008,277
Grand Total 2000	**7,453,993**	**6,714,792**	**234,304**	**2,910,547**	**602,532**	**6,987**	**240,919**	**275,245**	**85,410**	**1,039,239**	**19,563,968**

Table V-5 Detailed land use changes in East Kalimantan between 2000 and 2009

East Kalimantan	1 Primary Forest	2 Secondary Forest	3 Plantation Forest	4 Bushland	5 Agriculture	6 Paddy Field	7 Mining Areas	8 Crop Plantation	9 Settlement	Others	Grand Total 2000
1 Primary Forest	6,205,166	1,208,167		15,082	5,510		3,999	9,442	11	6,616	7,453,993
2 Secondary Forest		5,667,787	254,440	400,618	109,772	43	64,736	119,616	1,057	96,723	6,714,792
3 Plantation Forest		9,087	205,278	13,013	1,351		5,288	139	147		234,303
4 Bushland		7,609	48,615	1,928,080	737,248	7,371	43,129	134,887	3,387	219	2,910,545
5 Agriculture			40	216	596,998	4	2,387	1,193	1,359	333	602,530
6 Paddy Field					8	6,974		5			6,987
7 Mining Areas			485	2,505	15,092		212,737	5,422	197	4,483	240,921
8 Crop Plantation		73		123	44		2	274,411	579	13	275,245
9 Settlement				739	183	2	51	94	84,341		85,410
Others		2,974	1,916	5,726	35,394	300	15,854	70,324	3,756	902,998	1,039,242
Grand Total 2009	**6,205,166**	**6,895,697**	**510,774**	**2,366,102**	**1,501,600**	**14,694**	**348,183**	**615,533**	**94,834**	**1,011,385**	**19,563,968**

Table V-6 Detailed land use changes in SE Sulawesi between 1990 and 2000

SE Sulawesi	1 Primary Forest	2 Secondary Forest	3 Plantation Forest	4 Bushland	5 Agriculture	6 Paddy Field	7 Mining Areas	8 Crop Plantation	9 Settlement	Others	Grand Total 1990
1 Primary Forest	856,249	276,006	17	19,072	10,564		281	37	108	399	1,162,733
2 Secondary Forest		947,616		144,771	55,175	228	4,985	50	1,027	7,343	1,161,195
3 Plantation Forest			2,363								2,363
4 Bushland				423,523	4,230	848	6,403		672		435,676
5 Agriculture					776,737						776,737
6 Paddy Field						51,428					51,428
7 Mining Areas				591	402		8,053				9,046
8 Crop Plantation								20,216			20,216
9 Settlement									21,363		21,363
Others				827	355	263	280		377	17,608	19,710
Grand Total 2000	**856,249**	**1,223,622**	**2,380**	**588,784**	**847,463**	**52,767**	**20,002**	**20,303**	**23,547**	**25,350**	**3,660,467**

Table V-7 Detailed land use changes in SE Sulawesi between 2000 and 2009

SE Sulawesi	1 Primary Forest	2 Secondary Forest	3 Plantation Forest	4 Bushland	5 Agriculture	6 Paddy Field	7 Mining Areas	8 Crop Plantation	9 Settlement	Others	Grand Total 2000
1 Primary Forest	800,132	53,357		1,453	1,114			193			856,249
2 Secondary Forest		1,165,549		22,131	29,016		4,742	1,214		969	1,223,621
3 Plantation Forest			2,380								2,380
4 Bushland		142		580,855	5,156		516	2,114			588,783
5 Agriculture				422	845,364	19	20	1,639			847,464
6 Paddy Field					330	52,437					52,767
7 Mining Areas		44		433	202		19,322				20,001
8 Crop Plantation				2,534				17,769			20,303
9 Settlement									23,547		23,547
Others					27					25,368	25,395
Grand Total 2009	**800,132**	**1,219,092**	**2,380**	**607,828**	**881,209**	**52,456**	**24,600**	**22,929**	**23,547**	**26,337**	**3,660,510**

For the period 1990 to 2009, 91% of primary forest and 35% of secondary forest was lost in South Kalimantan. Mining areas increased by 329%, agricultural areas increased by 60% and crop plantation increased by 81% (see Table V-2 and V-3). In East Kalimantan, between 1990 and 2009, 24% of primary forests was lost, while plantation forest increased by 124%. Agricultural areas, paddy fields, mining areas, and crop plantation increased by 146%, 103%, 51% and 106% respectively (see Table V-4 and V-5). For the same period of time, 31% of primary forest in SE Sulawesi was lost, but secondary forest increased by 5%. Bushland also increased by 40%, mining areas increased by 172% and both agricultural areas and crop plantation increased by 13% (see Table V-6 and V-7).

Forest degradation occurred most in primary forest, while deforestation occurred most in forested land; primary, secondary and plantation forests (see Table V-2 – Table V-7). However, the majority of deforestation occurred in secondary forests. Consequently, this study focuses on the forest degradation in primary forest and deforestation in secondary forest.

Table V-8 presents primary forest degradation and secondary forest deforestation between 1990 and 2009. A decreasing trend in the rate of primary forest degradation occurred in South Kalimantan and SE Sulawesi, while the reverse was true for East Kalimantan. The deforestation decreased in South Kalimantan and SE Sulawesi but was almost constant in East Kalimantan (see Figure V-1 and Figure V-2).

Table V-8 Rate of primary forest degradation and secondary forest deforestation between 1990 and 2009

Province	Primary Forests 1990 (Ha)	Secondary Forests 1990 (Ha)	1990 and 2000			
			Degraded areas (Ha)	Degraded areas (%)	Deforested areas (Ha)	Deforested areas (%)
South Kalimantan	649,528	1,125,374	479,649	74	675,224	60
East Kalimantan	8,165,582	6,862,282	646,987	8	754,851	11
SE Sulawesi	1,162,733	1,161,195	276,006	24	209,015	18
Province	Primary Forests 2000 (Ha)	Secondary Forests 2000 (Ha)	2000 and 2009			
			Degraded areas (Ha)	Degraded areas (%)	Deforested areas (Ha)	Deforested areas (%)
South Kalimantan	63,098	863,089	1,269	2	125,669	15
East Kalimantan	7,453,993	6,714,791	1,208,167	16	792,566	12
SE Sulawesi	856,249	1,223,622	53,357	6	58,072	5

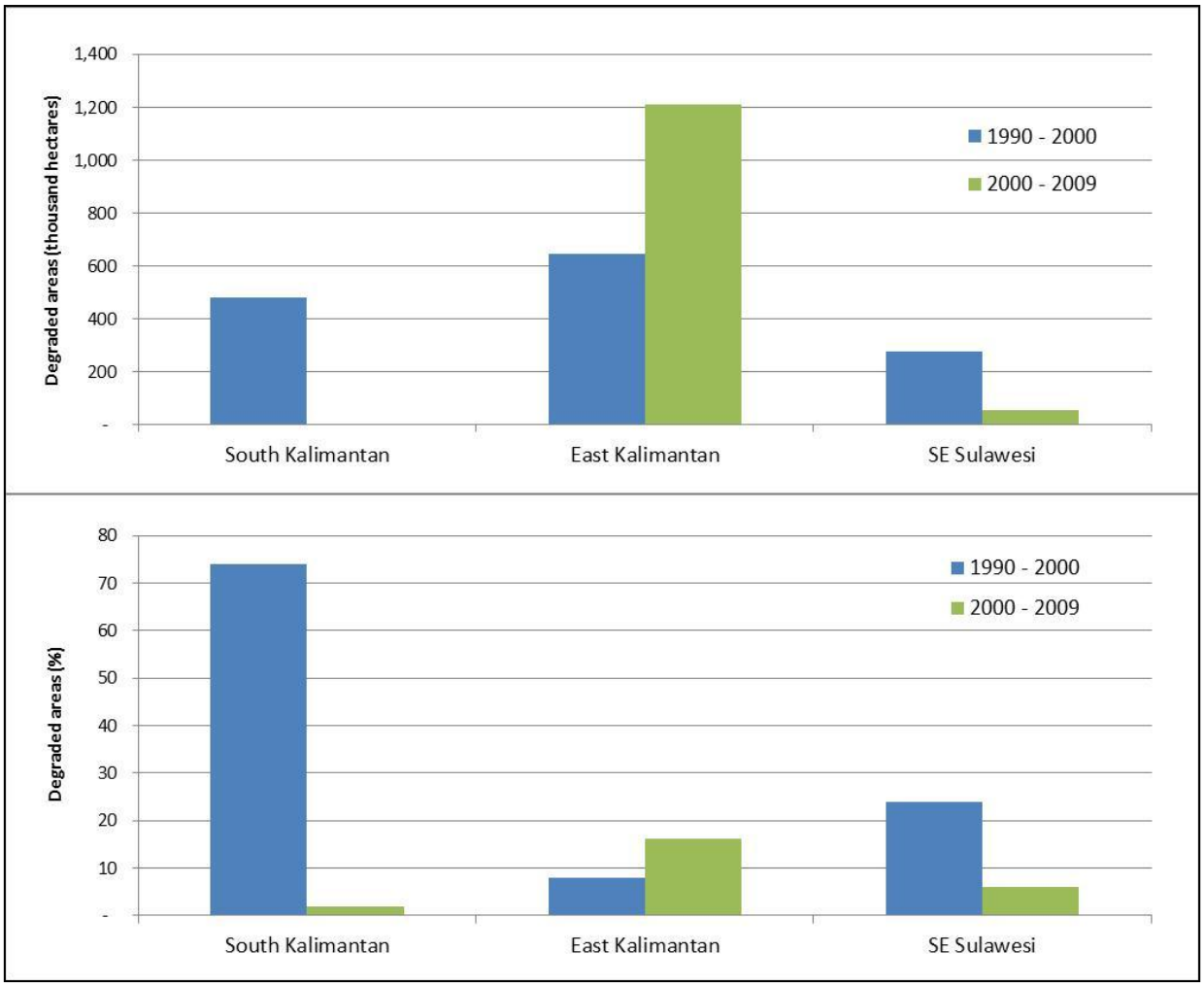


Figure V-1 Primary forest degraded areas between 1990 and 2009

Figure V-1 shows the degraded areas between 1990 and 2000 and 2000 and 2009 in South Kalimantan, East Kalimantan and SE Sulawesi. Between 1990 and 2000, 74% of primary forests in South Kalimantan degraded to secondary forests, 8% in East Kalimantan, and 24% in SE Sulawesi. In contrast to that period, between 2000 and 2009, only 2% (1,269 ha) of primary forests in South Kalimantan degraded to secondary forests. Forest degradation in East Kalimantan is by far the largest compared to the other provinces studied with 1,208,167 ha (16%) of primary forests degraded into secondary forests. Further, 53,357 ha (6%) of forests degradation occurred in SE Sulawesi.

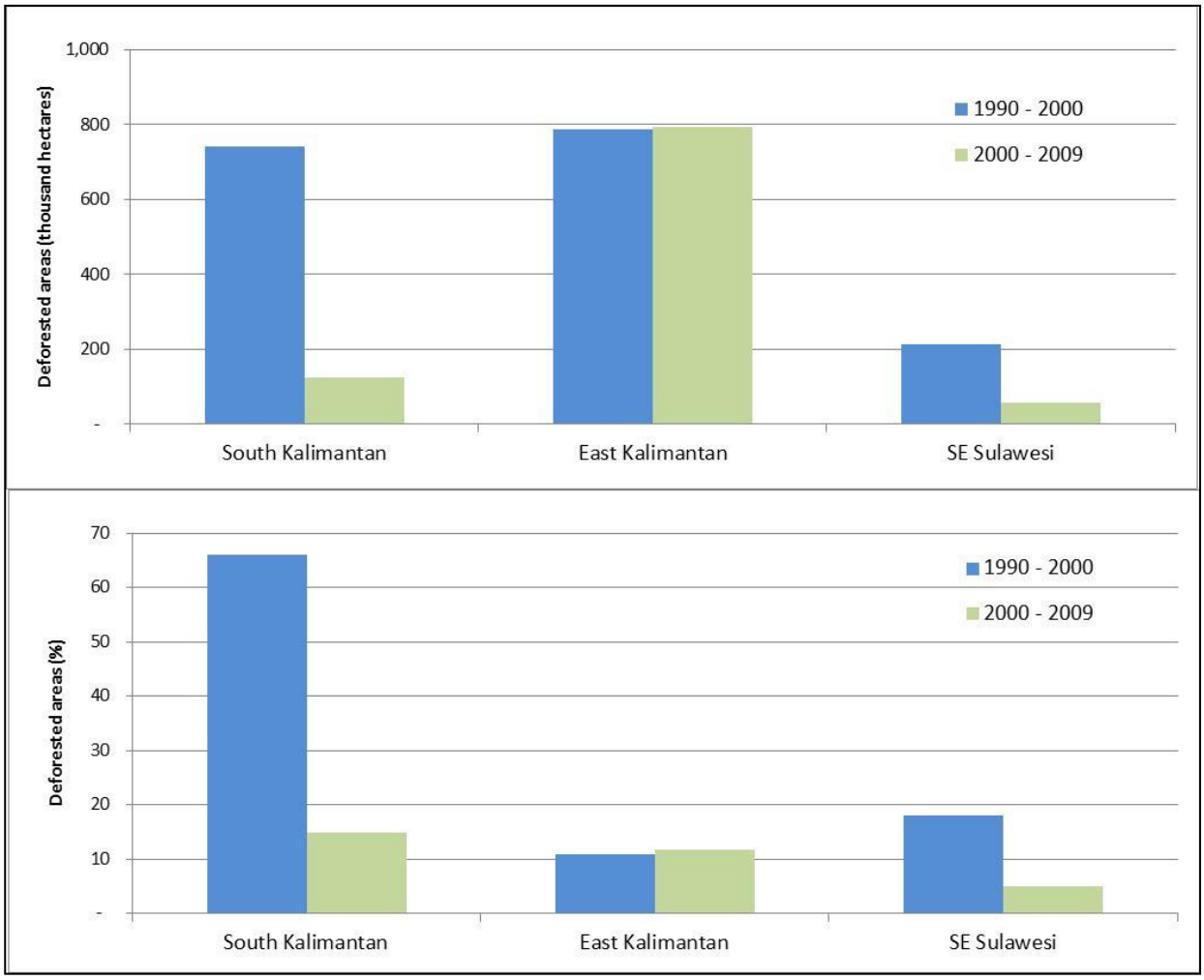


Figure V-2 Deforested areas in secondary forest between 1990 and 2009

Figure V-2 shows that for the period 1990 to 2000, secondary forest deforestation was 60% in South Kalimantan, 11% in East Kalimantan and 18% in SE Sulawesi. Between 2000 and 2009 secondary forest deforestation was 15% in South Kalimantan, 12% in East Kalimantan and 5% in SE Sulawesi.

Although forest degradation and deforestation have changed forest cover in the three provinces, reforestation did occur from non-forested areas into forested areas (see Table V-2 – Table V-7). In total, reforestation between 2000 and 2009 in the three provinces was 10,767 ha in South Kalimantan, 61,712 ha in East Kalimantan and 186 ha in SE Sulawesi. These figures include reforestation in secondary forests and plantation forests. Reforestation was mostly from bush lands to plantation forests; 7,443 ha in South Kalimantan and 48, 615 ha in East

Kalimantan (see Table V-3, Table V-5, and Table V-7). Surprisingly, between 1990 and 2000 no reforestation occurred in secondary forests. Reforestation only occurred in plantation forests; 5,777 ha in South Kalimantan and 2,996 ha in East Kalimantan (see Table V-2, Table V-4, and Table V-7).

Based on Table V-2 - Table V-7, net forest losses between 1990 and 2009 for all three provinces studied were calculated using Equation 3 and the results are presented in Table V-9. Total net forest loss in South Kalimantan and SE Sulawesi decreased over the past 20 years but increased in East Kalimantan. For the period of 1990 and 2009, South Kalimantan lost 52% of its forested land, East Kalimantan 17% and SE Sulawesi 13%.

Table V-9 Net forest loss

No	Province	Forest 1990 (Ha)	Forest 2000 (Ha)	Net Forest Loss (Ha)	Net Rate (ha/year)	Percent Rate (%)
1	South Kalimantan	1,884,501	1,042,895	841,609	84,161	45
2	East Kalimantan	15,255,720	14,403,089	852,631	85,263	6
3	SE Sulawesi	2,326,291	2,082,251	244,040	24,404	10
No	Province	Forest 2000 (Ha)	Forest 2009 (Ha)	Net Forest Loss (Ha)	Net Rate (ha/year)	
1	South Kalimantan	1,042,895	912,705	130,190	14,465	12
2	East Kalimantan	14,403,089	12,611,636	1,791,453	199,050	12
3	SE Sulawesi	2,082,251	2,021,605	60,832	6,759	3

3. Land use patterns and changes between 2000 and 2009

To determine deforestation and forest degradation, land use patterns and changes within the three selected provinces were analysed. Land use in the three provinces shows different patterns (see Figure V-3) and land utilization for human-based activities is very much linked to the population size. South Kalimantan, the most populated province has the highest proportion of agricultural land (36%) and paddy fields (7%) followed by SE Sulawesi with 24% and 1.4%. East Kalimantan, the most sparsely populated province of the three provinces studied, has 70% of its area in forests and utilizes little land for agricultural development (3%) and even less for paddy fields (0.04%). Population pressure appears to strongly affect the use of the land. Land use at 2009 is presented in Figure V-3.

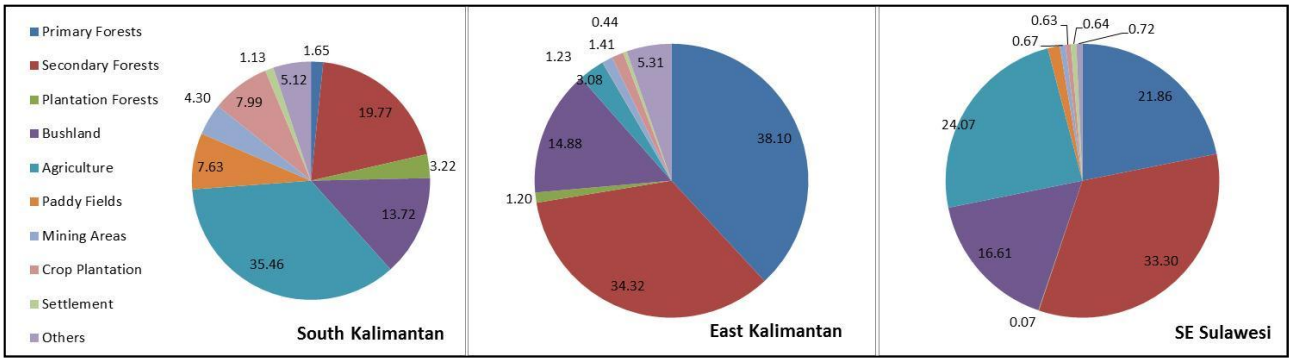


Figure V-3 Land use 2009

Between 2000 and 2009, a number of paddy fields were established and new mining areas were developed in South Kalimantan (see Figure V-4). In this province, there was a reduction in secondary forests, bush lands and agriculture, as well as an increase in paddy fields, mining activities and crop plantation. Figure V-5 shows that 15% of secondary forests and 3% of primary forests were lost between 2000 and 2009, while paddy fields increased by 25% and mining areas increased by 110%. Over the period, crop plantation in South Kalimantan increased by 42% (see Figure V-5).

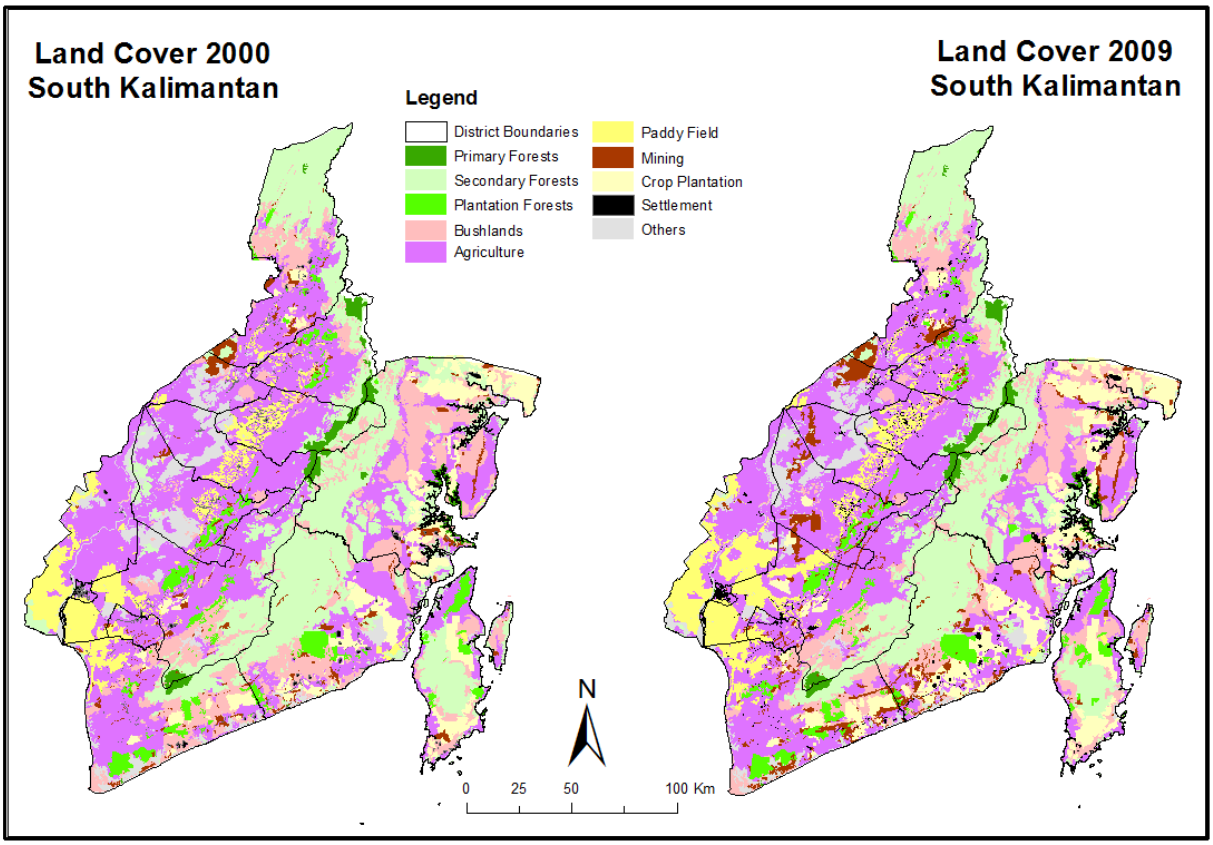


Figure V-4 Land cover 2000 and 2009 in South Kalimantan

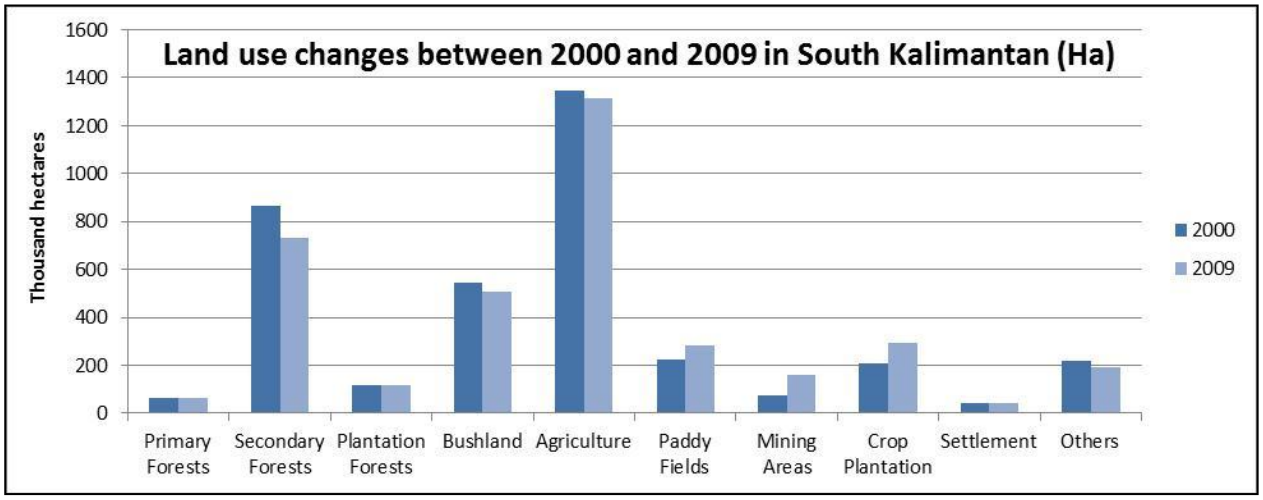


Figure V-5 Land use changes in South Kalimantan between 2000 and 2009

A relatively large area of primary forest was lost in East Kalimantan (see Figure V-6). This primary forest has degraded into secondary forest. Another important land use change in this province is the alteration of secondary forests into plantation forests and the improvement of bush lands into agricultural land, as indicated in Figure V-6.

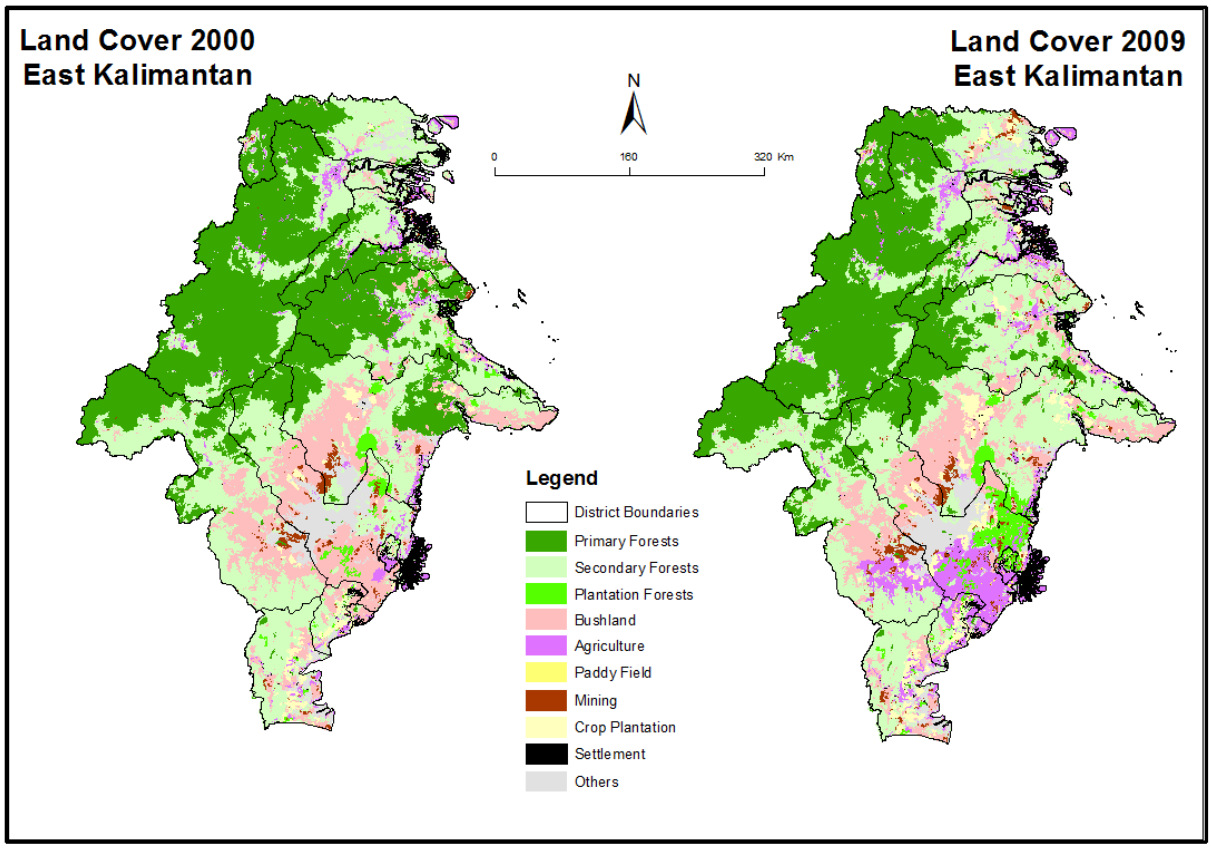


Figure V-6 Land cover 2000 and 2009 in East Kalimantan

In East Kalimantan, the decrease in primary forest explains to some extent the increasing areas of secondary and plantation forests. Figure V-7 indicates that from 2000 to 2009, 17% of primary forests were lost, while at the same time, total secondary forests and plantation forests increased by 3% and 118% respectively. Furthermore, agriculture, mining areas and crop plantation increased by 150%, 44% and 124% respectively. Total bush lands, however, decreased during the period 2000 to 2009 (see Figure V-7).

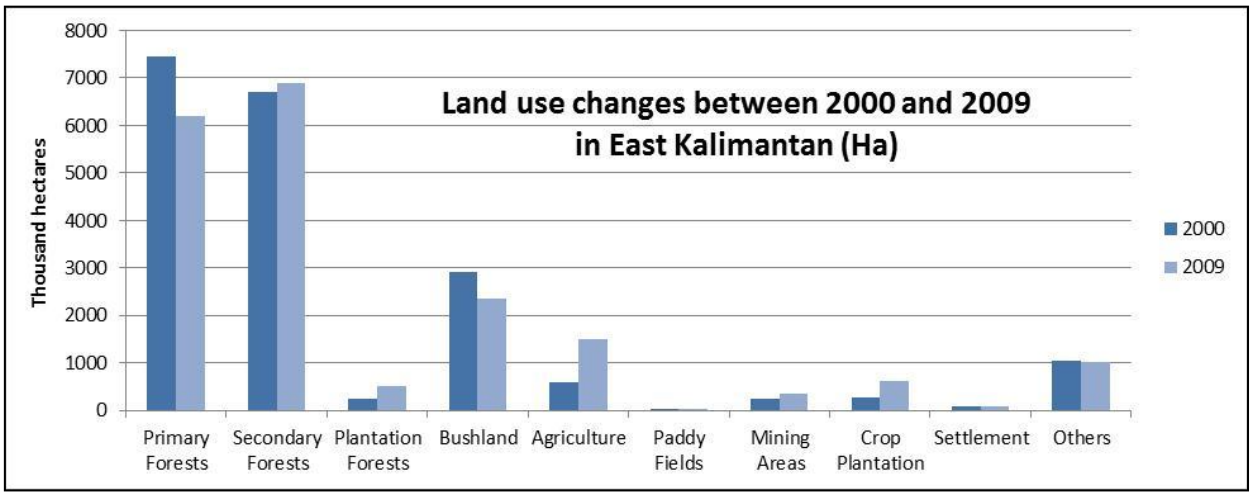


Figure V-7 Land use changes in East Kalimantan between 2000 and 2009

In SE Sulawesi, land use has not changed much. However, some primary forest in the southern part of mainland SE Sulawesi was lost and secondary forests were converted into mining sites (see Figure V-8). Primary forests and secondary forests decreased by 7% and 0.37% (see Figure V-9). This figure shows that mining areas increased by 23% and crop plantation increased from 20,303 ha to 22,929 ha (13%). Bushland and agricultural areas also increased by 3% and 4% respectively as shown in Figure V-9.

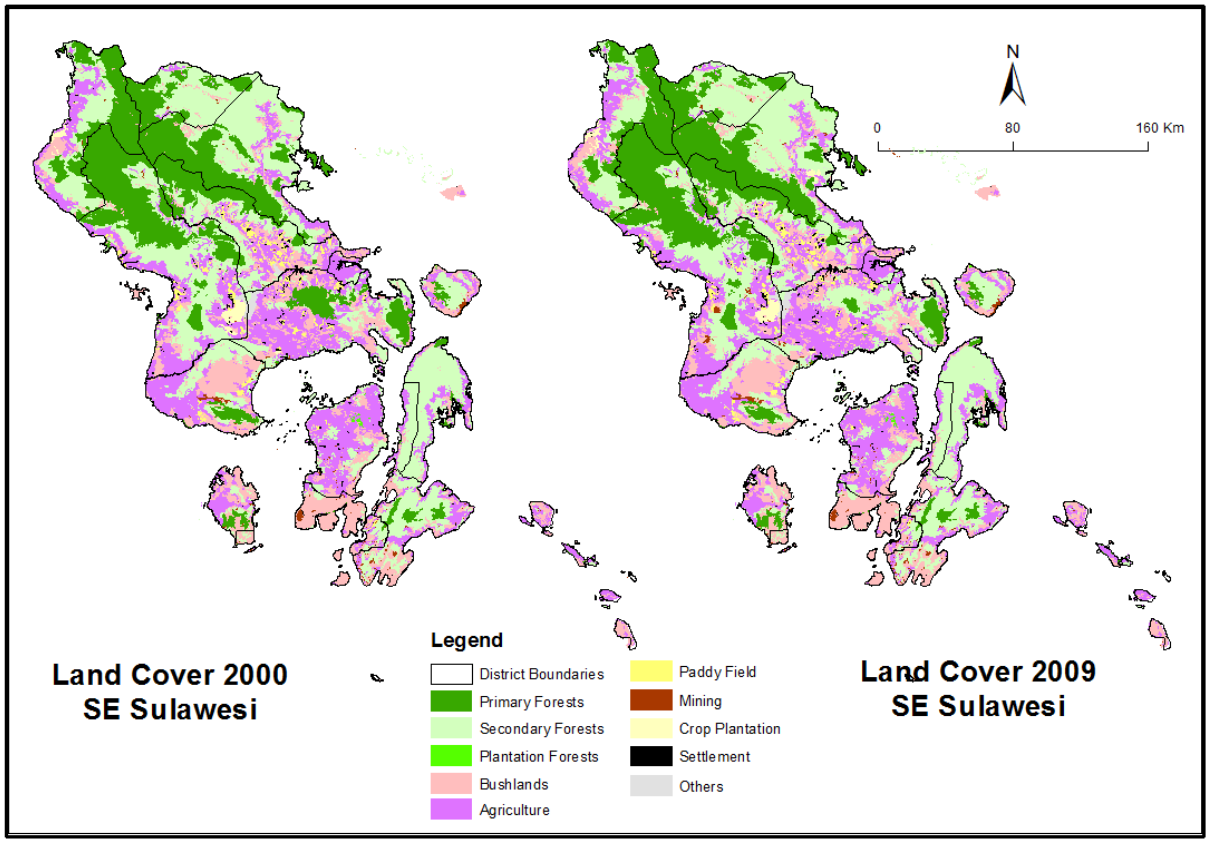


Figure V-8 Land cover 2000 and 2009 in SE Sulawesi

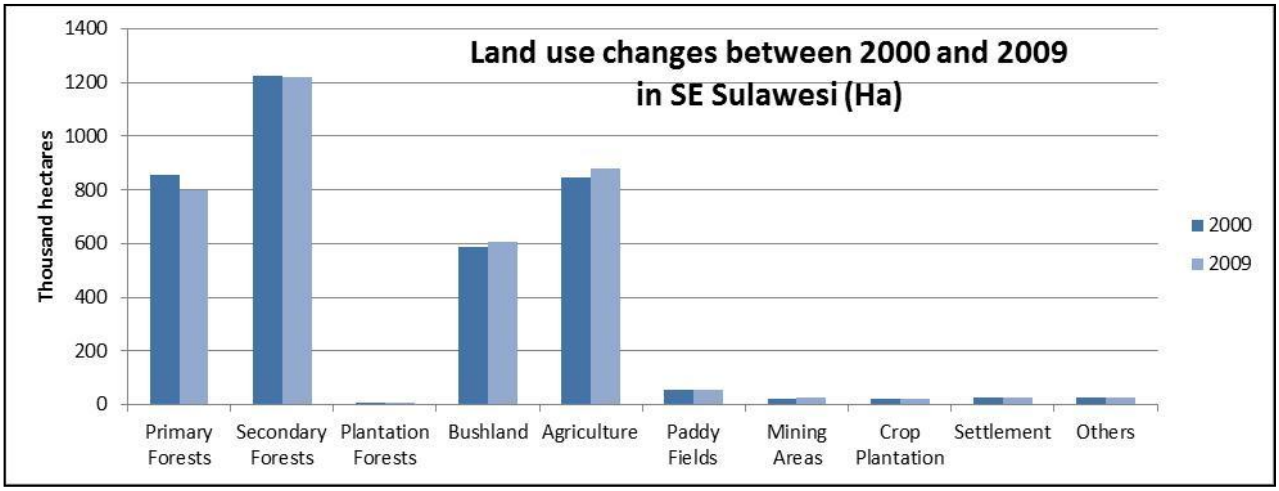


Figure V-9 Land use changes in SE Sulawesi between 2000 and 2009

4. Forest Changes

Forest changes, deforestation and forest degradation, occurred in the three provinces with different patterns. Details of forest changes are presented in Figure V-10 – Figure V-12. These figures reveal that in all three provinces, although some deforestation occurred in primary forests and plantation forests, deforestation occurred most in secondary forests. Again, this is the main reason for this thesis to focus on the deforestation of secondary forests. Appendix C – Appendix H present maps of forest cover between 2000 and 2009 and maps of forest degradation and deforestation in South Kalimantan, East Kalimantan and SE Sulawesi.

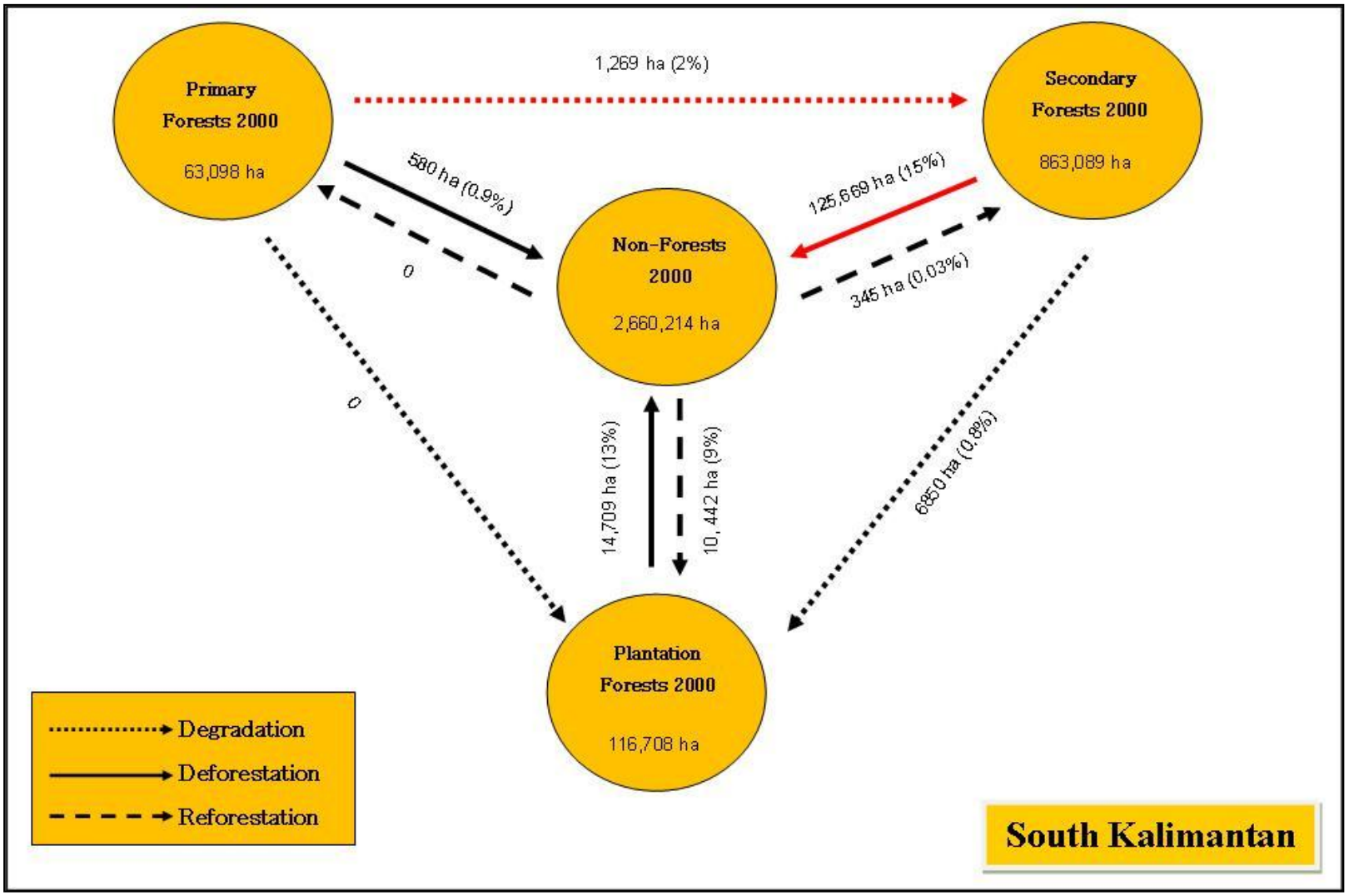


Figure V-10 Forest degradation and deforestation in South Kalimantan

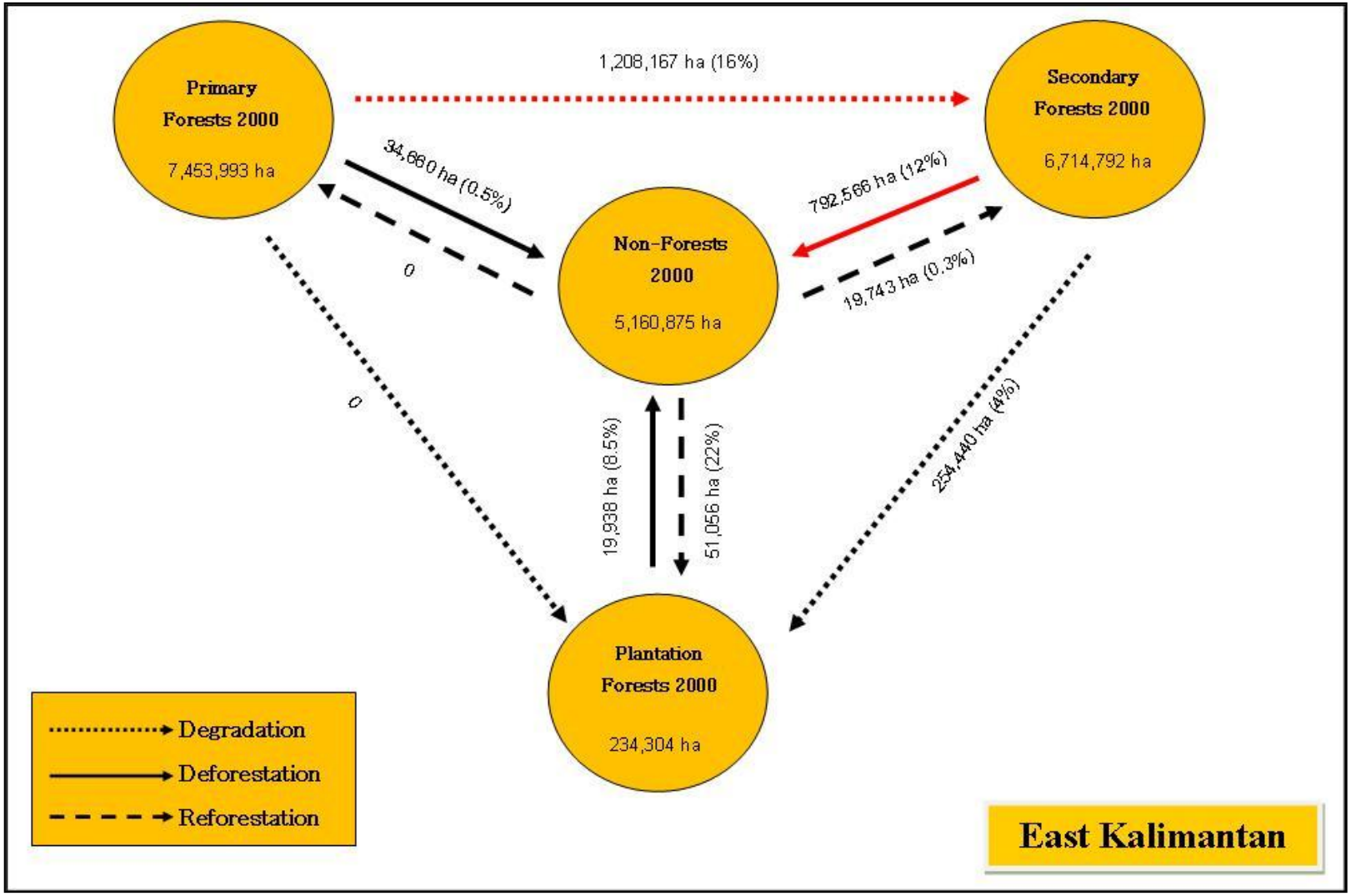


Figure V-11 Forest degradation and deforestation in East Kalimantan

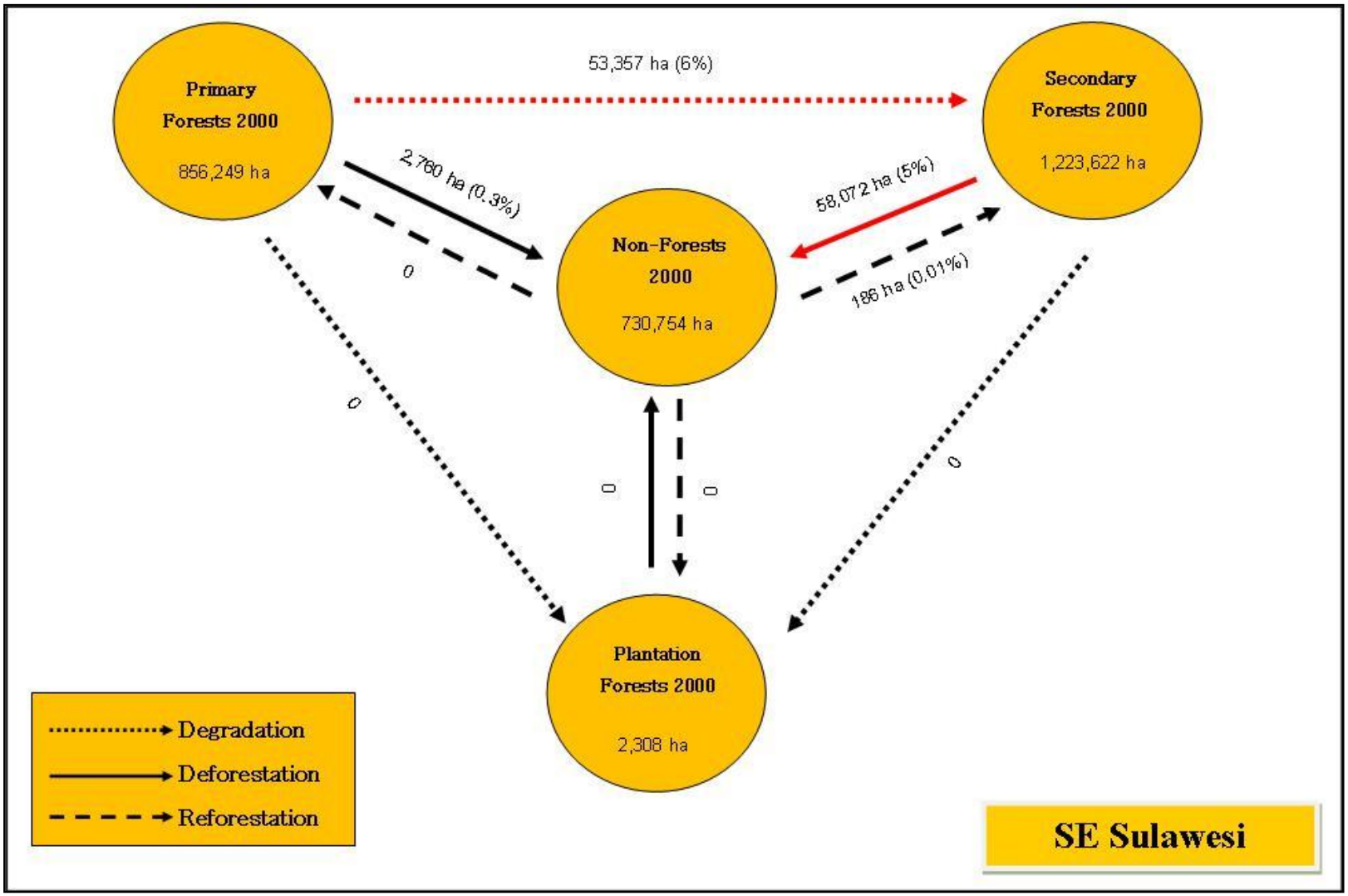


Figure V-12 Forest degradation and deforestation in SE Sulawesi

a) Changes in the area of forest estates

This study shows that forest degradation and deforestation have occurred across the official forest land use (forest estate) and other utilisation areas (non-forest areas/*Areal Penggunaan Lain - APL*) and do not follow official forest boundaries. Although the Indonesian Ministry of Forestry has designated forest estates based on their functions, Table V-10, Table V-11, Figure V-13, and Figure V-14 present the fact that degradation and deforestation occurred in the official forest land use zone (forest estate).

Forest degradation existed within the official forest areas in all the three provinces studied (see Table V-10 and Figure V-13). In total, 39%, 71% and 94% of forest degradation occurred in the official forest areas, and 61%, 29% and 5% of forest degradation occurred in non-forest areas (APL) in South Kalimantan, East Kalimantan and SE Sulawesi respectively.

Forest clearing is actually prohibited in biodiversity conservation forests and watershed protection forests, but high rate of forest degradation occurred in these forest land use zones of South Kalimantan and SE Sulawesi (see Figure V-13). Almost 40% of degraded areas in South Kalimantan occurred in biodiversity conservation forests, and 57% of degraded areas in SE Sulawesi were in watershed protection forests. Timber from production forests is allowed to be extracted, but sustainable management natural production forests should be applied. However, almost 40% of degraded areas in East Kalimantan were in production forests (as presented in Figure V-13).

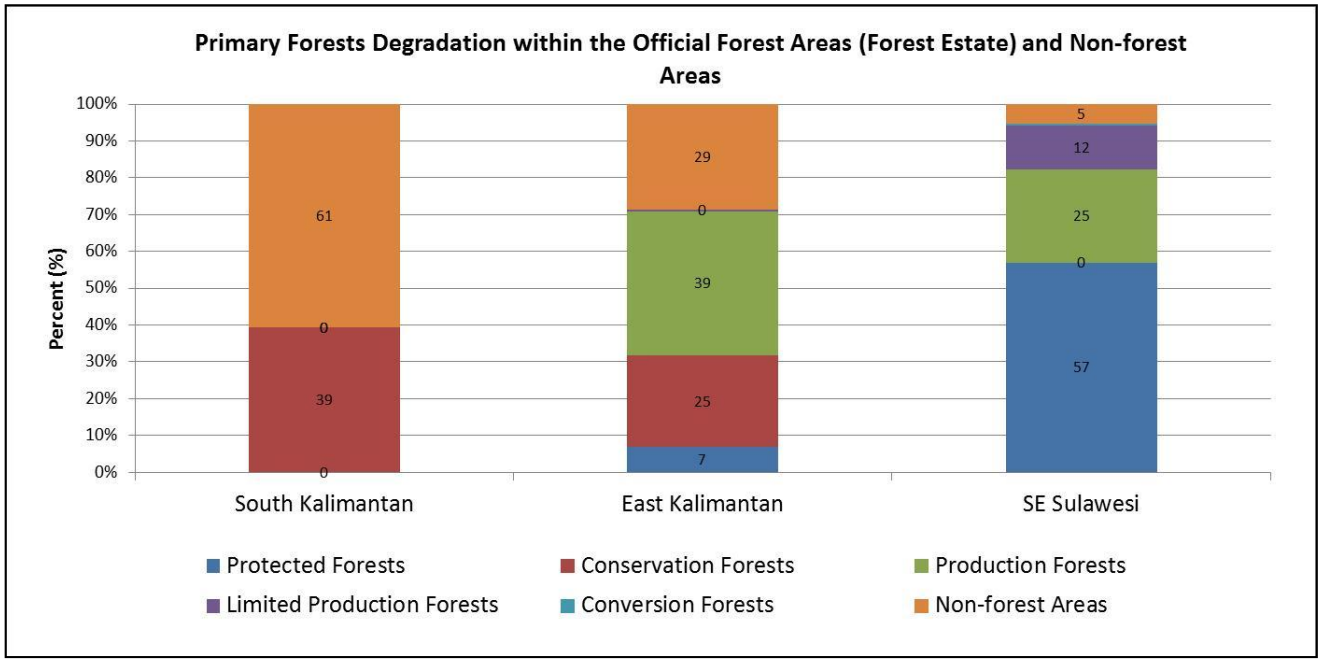


Figure V-13 Primary forest degradation within the official forest areas (forest estate) and non-forest areas

Similarly to forest degradation, deforestation also existed within the official forest areas in all three provinces studied (see Table V-11 and Figure V-14). In total, 52%, 53% and 83% of deforestation occurred in the official forest areas, and 48%, 47% and 16% of deforestation occurred in non-forest areas (APL) in South Kalimantan, East Kalimantan and SE Sulawesi respectively.

Land conversion is banned in the official forest estate except in the conversion forests where it is permitted under specific requirements including a legal licence needs to be sought from the Ministry of Forestry (MoF). Indeed, 29% and 34% of deforestation in South Kalimantan and East Kalimantan respectively occurred in production forests, and 34% of deforestation in SE Sulawesi occurred in protected forests (see Figure V-14).

Surprisingly, only 3% of deforestation in South Kalimantan and 4% in SE Sulawesi occurred in conversion forests, where a legal land conversion can take place. There are no conversion forests designated as official forest areas of East Kalimantan

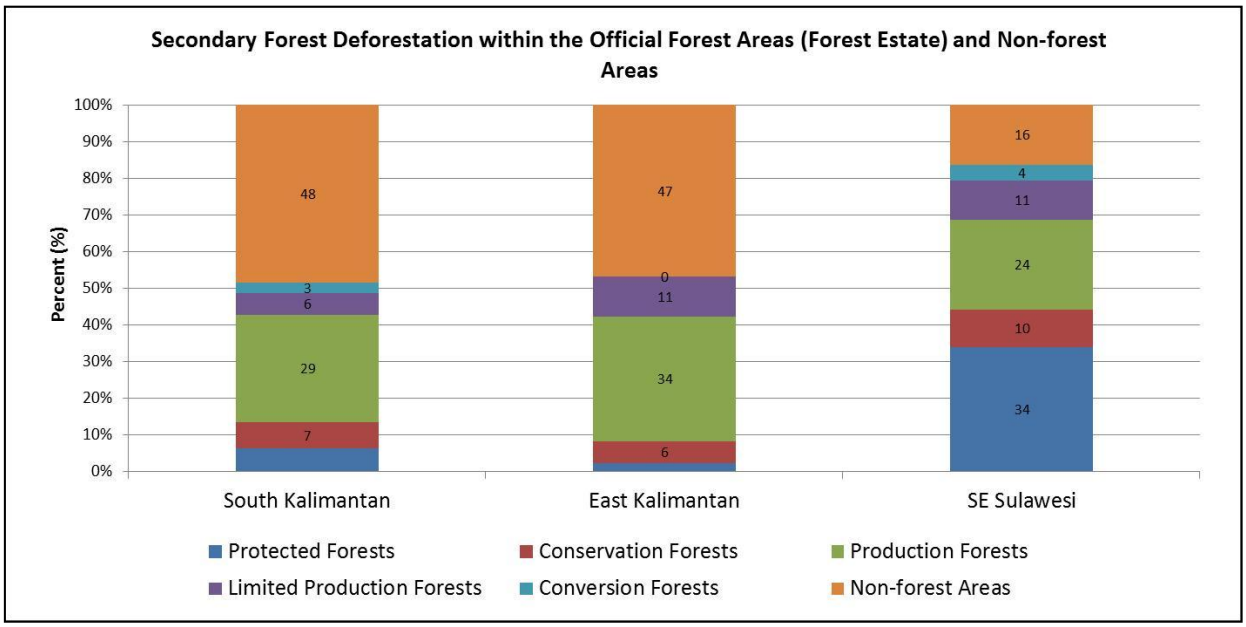


Figure V-14 Secondary forest deforestation within the official forest areas (forest estate) and non-forest areas

Table V-10 Primary forest degraded areas within forest estates and non-forest areas

Province	Primary forest degradation (Ha)	Rate of primary forest degradation (%)	Primary forest degraded areas within the official forest land use areas							
			Protected (Ha)	Protected (%)	Conservation (Ha)	Conservation (%)	Production (Ha)	Production (%)	Limited Production (Ha)	Limited Production (%)
South Kalimantan	1,269	2	0	0	500	39	0	0	0	0
East Kalimantan	1,208,167	16	83,853	7	301,435	25	472,316	39	5,864	0
SE Sulawesi	53,357	6	30,150	57	0	0	13,330	25	6,338	12

Province	Primary Forest Degradation (Ha)	Rate of Primary Forest Degradation (%)	Primary forest degraded areas within the official forest land use areas						Non Forest	
			Conversion (Ha)	Conversion (%)	Water Body (Ha)	Water Body (%)	Total Forest (Ha)	Total Forest (%)	Ha	%
South Kalimantan	1,269	2	0	0	0	0	500	39	770	61
East Kalimantan	1,208,167	16	0	0	0	0	862,468	711	345,698	29
SE Sulawesi	53,357	6	241	0	0	0	50,058	94	2,862	5

Table V-11 Secondary forest deforested areas within the official forest land use zones and non-forest areas

Province	Secondary forest deforestation (Ha)	Rate of secondary forest deforestation (%)	Secondary forest deforested areas within the official forest land use areas							
			Protected (Ha)	Protected (%)	Conservation (Ha)	Conservation (%)	Production (Ha)	Production (%)	Limited Production (Ha)	Limited Production (%)
South Kalimantan	125,668	15	7,827	6	9,114	7	36,773	29	7,411	6
East Kalimantan	792,566	12	17,460	2	46,255	6	271,567	34	85,428	11
SE Sulawesi	58,073	4	19,577	34	5,876	10	14,201	24	6,121	11

Province	Secondary forest deforestation (Ha)	Rate of secondary forest deforestation (%)	Secondary forest deforested areas within the official forest land use areas						Non Forest	
			Conversion (Ha)	Conversion (%)	Water Body (Ha)	Water Body (%)	Total Forest (Ha)	Total Forest (%)	Ha	%
South Kalimantan	125,668	15	3,593	3	21	0	64,739	52	60,929	48
East Kalimantan	792,566	12	0	0	6	0	420,717	53	371,849	47
SE Sulawesi	58,073	4	2,539	4	11	0	48,325	83	9,370	16

b) Forest degradation

Maps of forest degradation were compared with maps of selected variables (see Table III-6 in Chapter 3 for a list of variables) in order to see if there was any association.

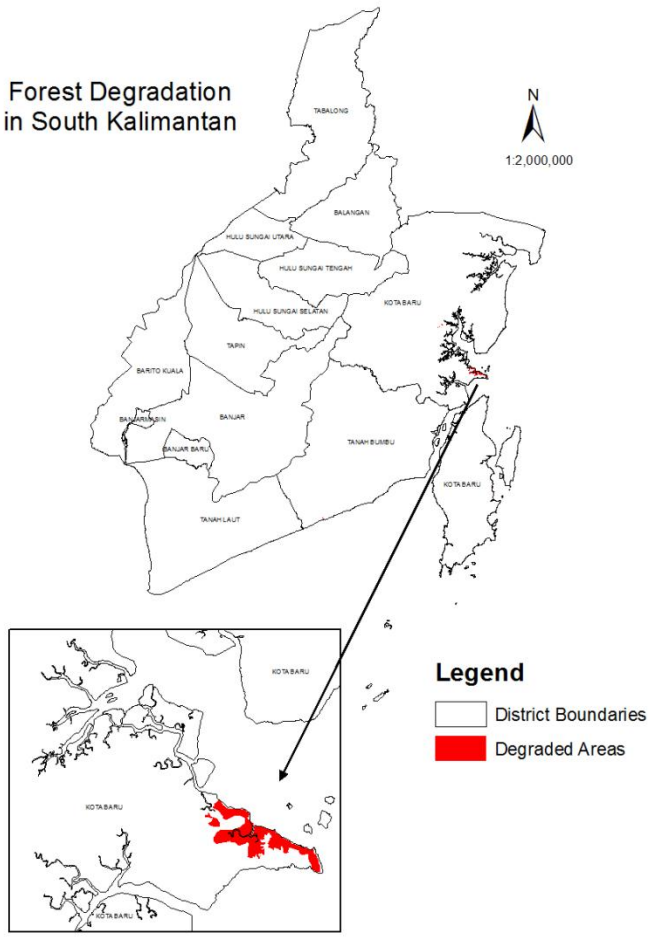
Figure V-15 – Figure V-19, and Table V-12 show across all three provinces studied how much forest degradation occurred within the area of forest concessions (natural concessions and industrial plantation concessions)and flat areas; or within and adjacent to community-based concessions, mining sites, transmigration villages and existing road infrastructure.

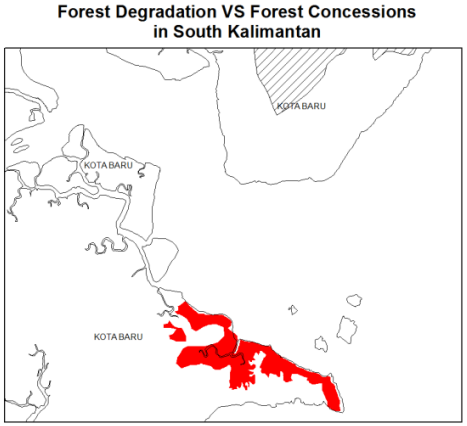
Figure V-15 depicts forest degradation in South Kalimantan. Degraded areas were not located inside forest concessions or mining sites, nor within community-based plantation forests. However, forest degradation in South Kalimantan was associated with the degree of slope < 25% and transmigration villages. In this province, primary forest is fragmented (Figure V-4). This edge habitat, which is vulnerable to being degraded or converted to other land uses, explains the occurrence of forest degradation in South Kalimantan.

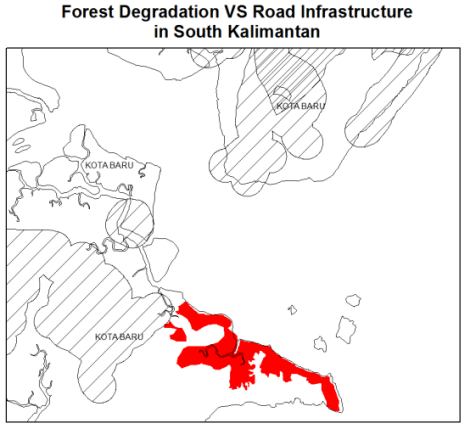
Figure V-16 and Figure V-17 show forest degradation in East Kalimantan. Unlike South Kalimantan, degraded areas in this province are linked to forest concessions and community-based plantation forests. Some degraded areas were also associated with mining sites, transmigration areas, road network and flat areas (see Figure V-17).

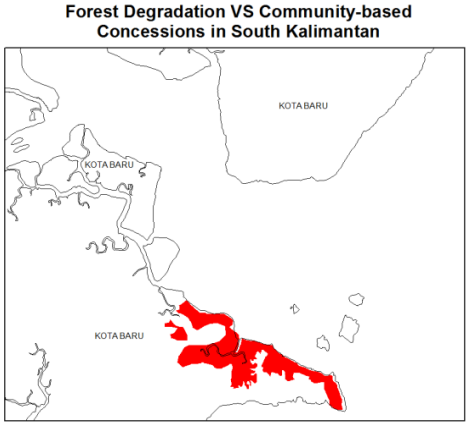
Figure V-18 and Figure V-19 present forest degradation in SE Sulawesi. Degraded areas are linked to forest concessions, community-based concessions and transmigration areas. Furthermore, degraded areas in this province were more related to hilly and mountainous areas rather than to flat areas, as the geographic condition of this province is dominated by hilly and mountainous areas (BPS, 2012).

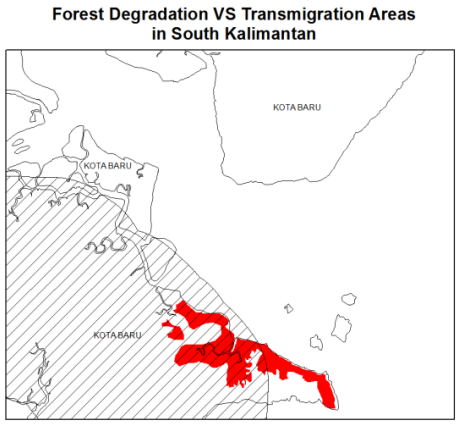
Figure V-15 Forest Degradation in South Kalimantan

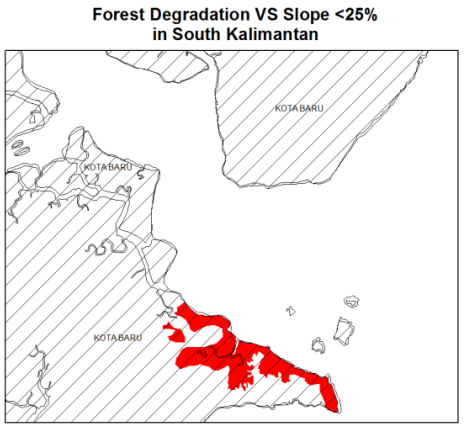












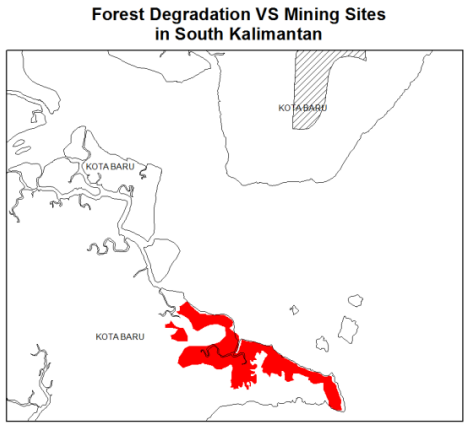
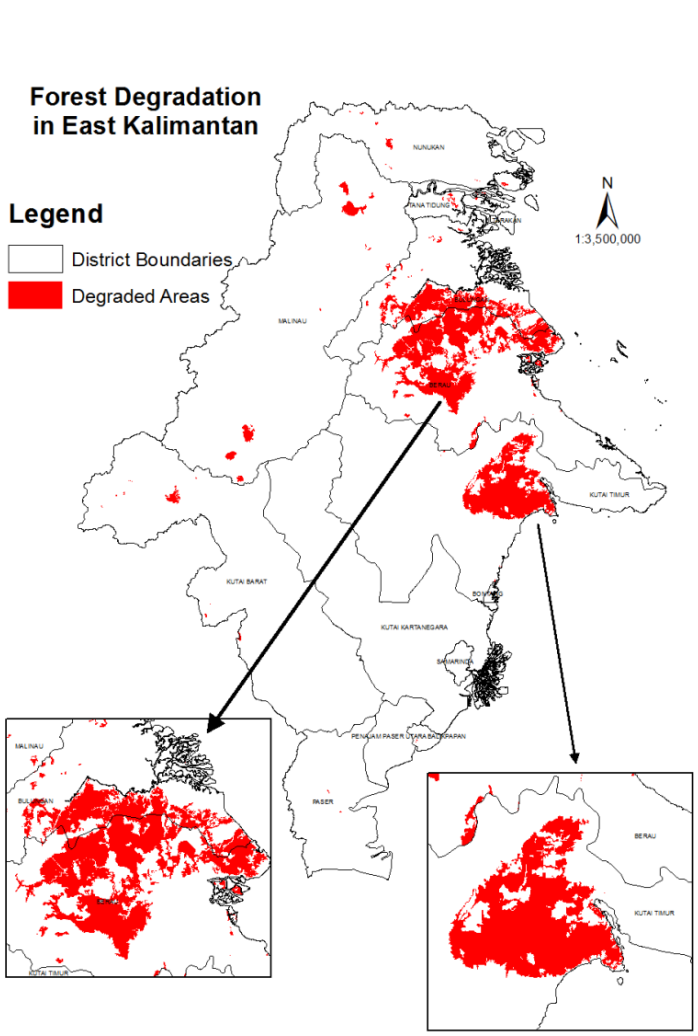
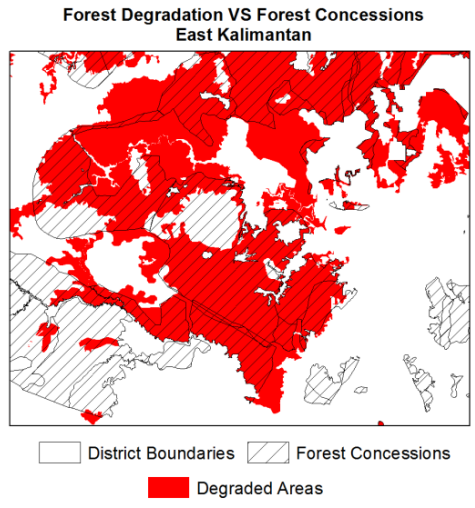
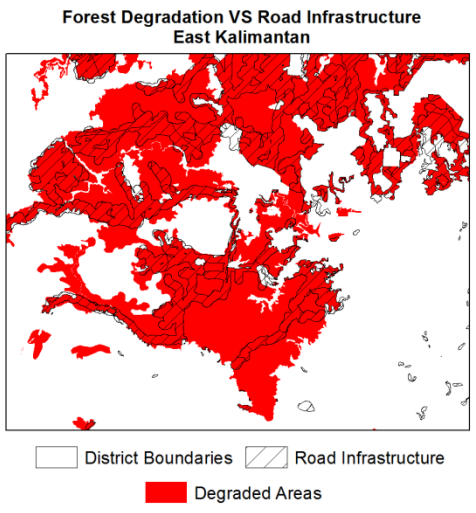
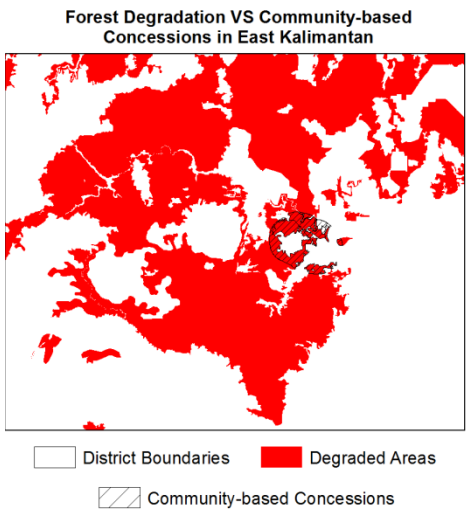


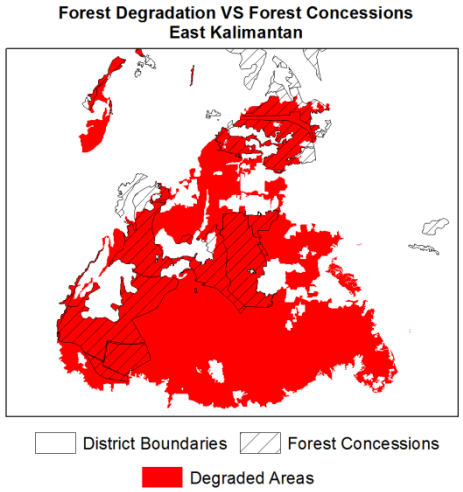
Figure V-16 Forest degradation in East Kalimantan

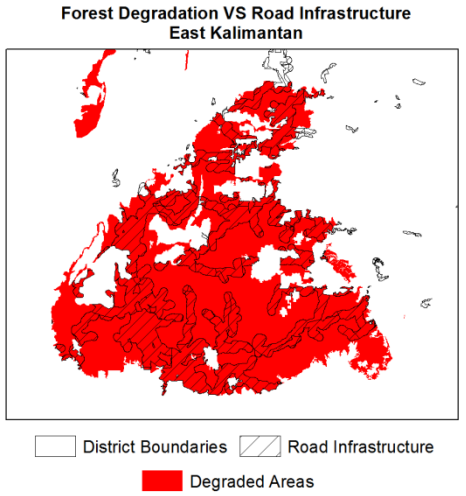












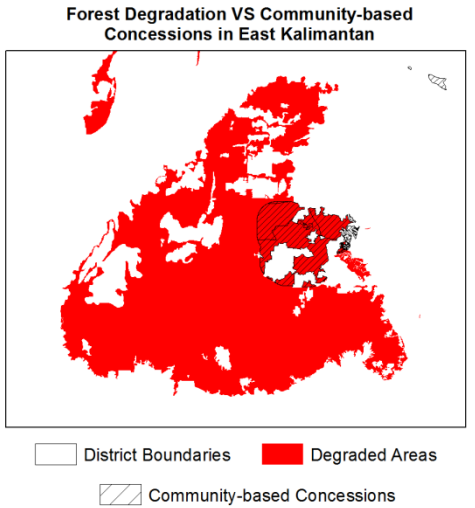


Figure V-17 Forest Degradation in East Kalimantan

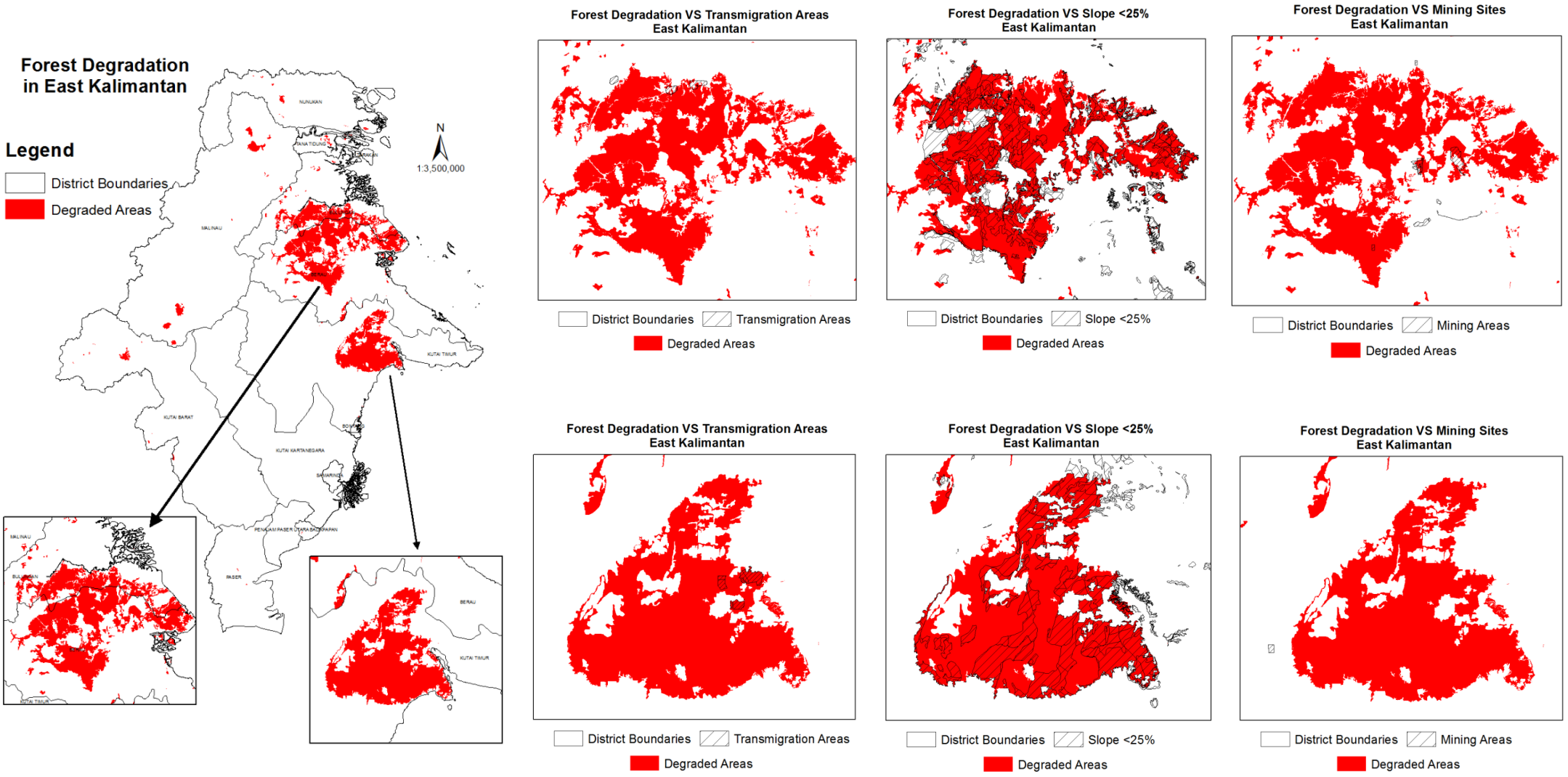


Figure V-18 Forest Degradation in SE Sulawesi

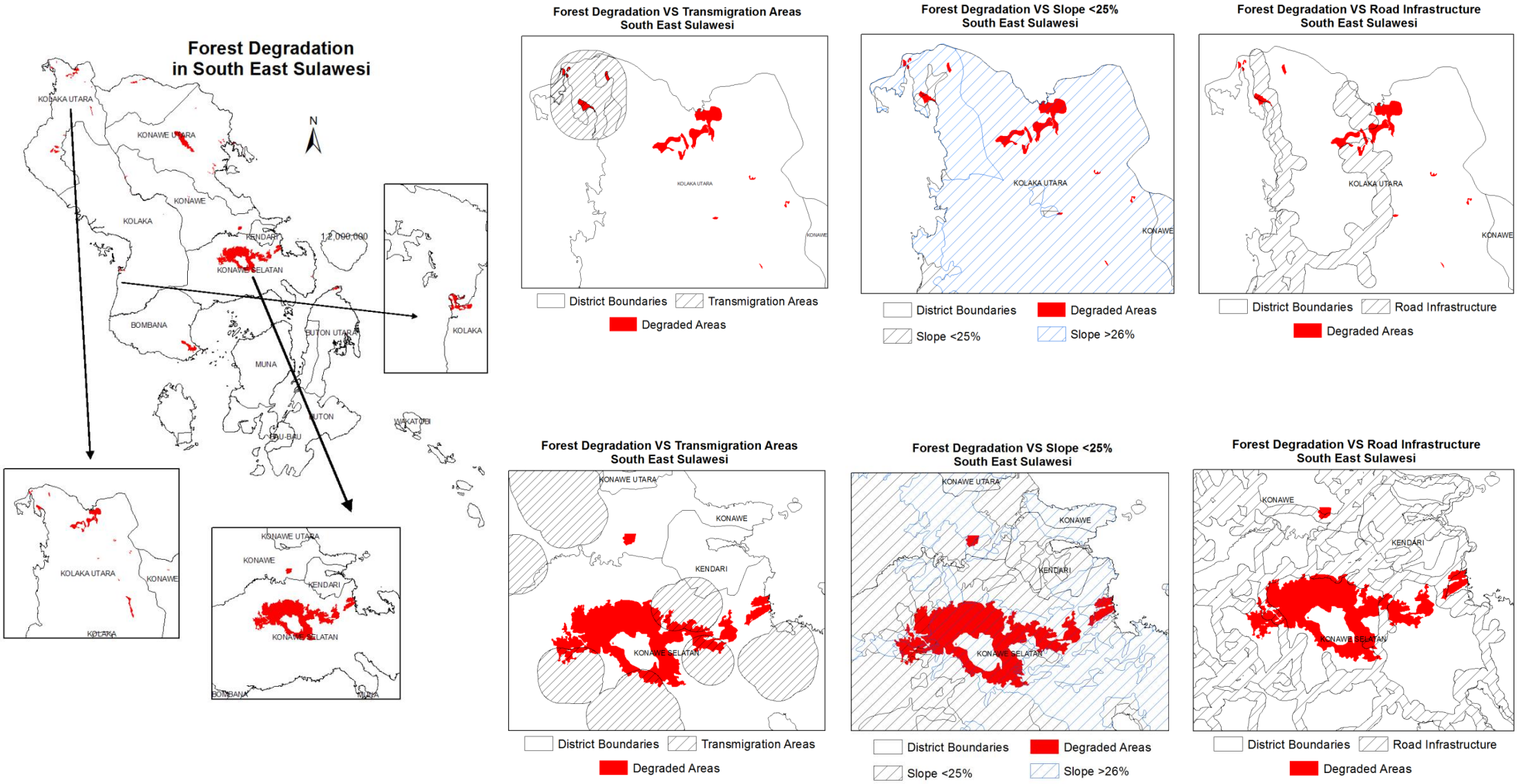
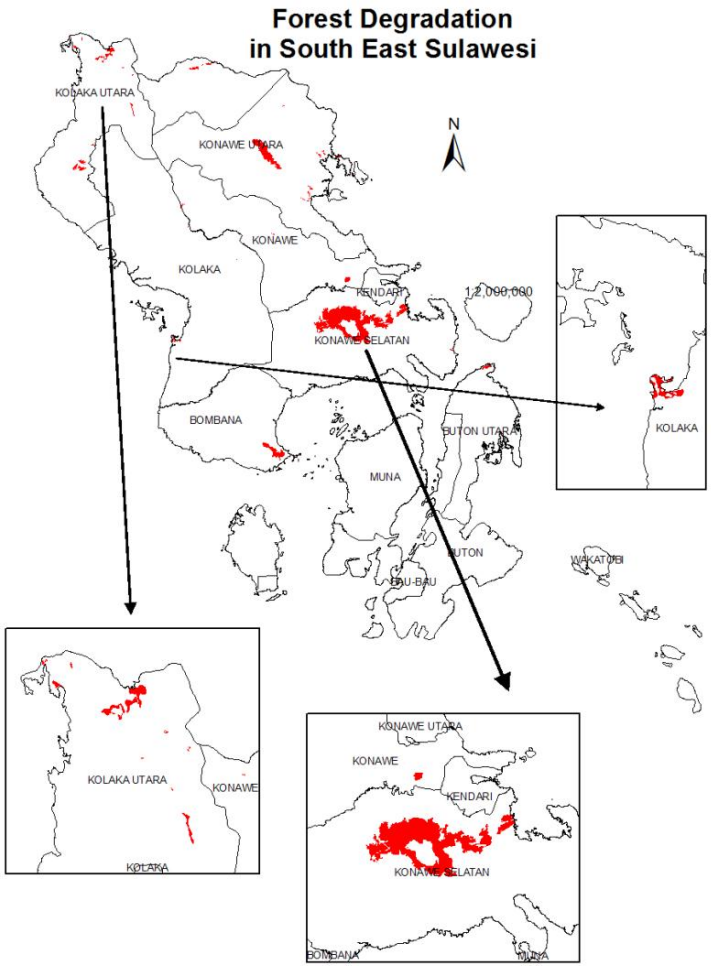
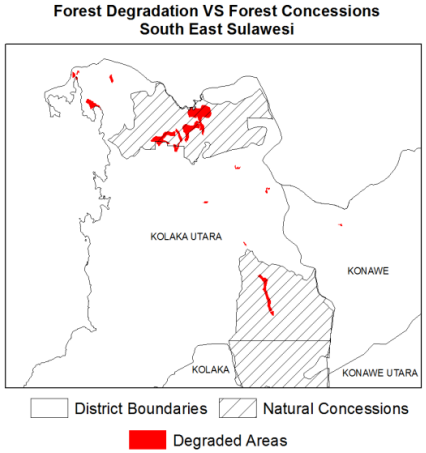
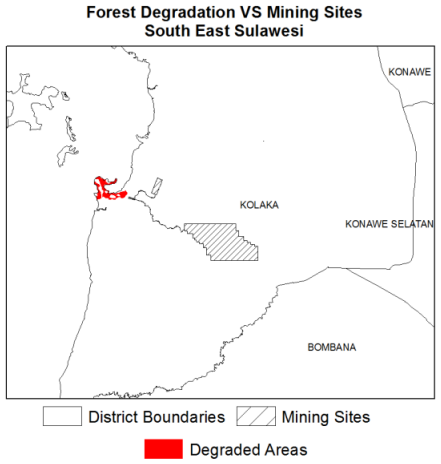
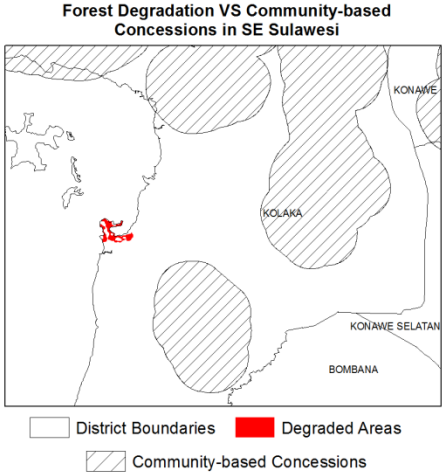


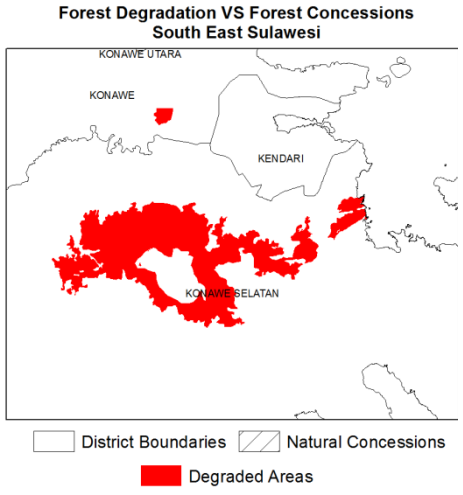
Figure V-19 Forest degradation in SE Sulawesi

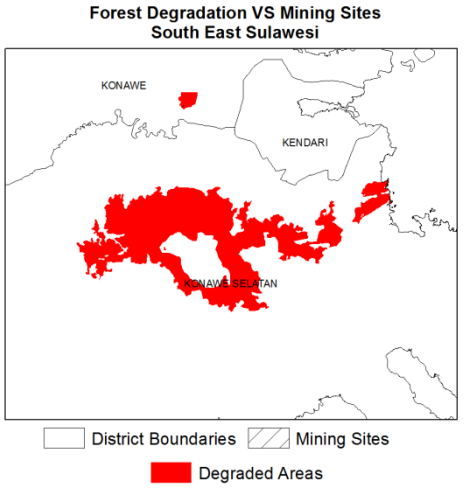












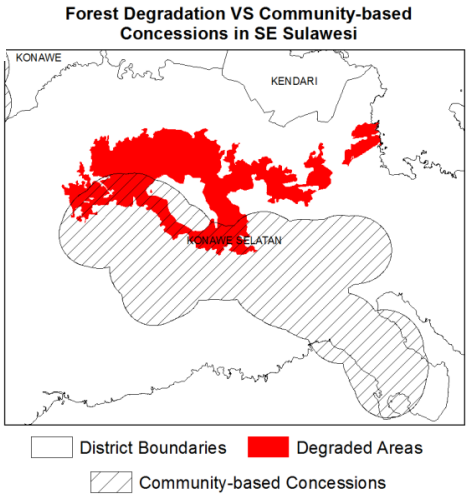


Table V-12 Proportion of primary forest degraded areas that occurs in the categories of selected direct and underlying causes

Province	Primary forests (Ha)	Primary forest degradation (Ha)	Rate of primary forest degradation (%)	Proportion of primary forest degraded areas that occurs in the categories of selected direct and underlying causes							
				Natural (Ha)	Natural (%)	Plantation (Ha)	Plantation (%)	Total forest concessions (Ha)	Total forest concessions (%)	Comm-based (Ha)	Comm-based (%)
South Kalimantan	63,098	1,269	2	0	0	0	0	0	0	0	0
East Kalimantan	7,453,993	1,208,167	16	598,206	50	113,699	9	711,905	59	18,266	2
SE Sulawesi	850,873	53,356	6	2,304	4	0	0	2,304	4	10,546	20
Province	Primary forests (Ha)	Primary forest degradation (Ha)	Rate of primary forest degradation (%)	Proportion of primary forest degraded areas that occurs in the categories of selected direct and underlying causes							
				Mining sites (Ha)	Mining sites (%)	Transmigration (Ha)	Transmigration (%)	Slope (Ha)	Slope (%)	Road (Ha)	Road (%)
South Kalimantan	63,098	1,269	2	0	0	1,204	95	1,269	100	79	6
East Kalimantan	7,453,993	1,208,167	16	5060	0	45,139	4	603,050	50	592,933	49
SE Sulawesi	850,873	53,356	6	18	0	11,803	22	6,312	12	6,882	13

Table V-13 Rate of primary forest degradation in different categories of selected direct and underlying causes

Province	Primary forests (Ha)	Primary forest degradation (Ha)	Rate of primary forest degradation (%)	Rate of primary forest degradation in different categories of selected direct and underlying causes							
				Natural (%)	Plantation (%)	Total forest concessions (%)	Comm-based (%)	Mining sites (%)	Transmigration (%)	Slope (%)	Road (%)
South Kalimantan	63,098	1,269	2	0	0	0	0	0	43	3	2
East Kalimantan	7,453,993	1,208,167	16	27	78	30	2	72	87	56	77
SE Sulawesi	850,873	53,356	6	3	0	3	16	2	16	18	31

Table V-12 presents the proportion of primary forest degraded areas that occurs in the selected areas of human-based activities (forest concessions, mining sites and transmigration areas), as well as in the proximity to road network and the flat areas of South Kalimantan, East Kalimantan and SE Sulawesi. Table V-13 gives the rate of primary forest degradation within the primary forest of forest concessions, transmigration areas, mining sites, road network and flat areas of the case study locations. For example, a total of 52,075 ha of primary forest in East Kalimantan were located within transmigration areas. Around 45,139 ha of the area were degraded between 2000 and 2009; therefore the rate of primary forest degradation within the transmigration areas was 87%.

Overall, 95% of primary forest degradation in South Kalimantan, 65% in East Kalimantan and 46% in SE Sulawesi were associated with direct causes such as forest concessions, mining activities and the government-sponsored relocation program. The transmigration program in South Kalimantan and SE Sulawesi contributed to the highest percentage of primary forest degraded areas in these provinces: 95% and 22% respectively, while forest concessions (59%) were the largest contributor in East Kalimantan primary forest degradation (see Table V-12). Underlying causes such as the existence of road networks and the degree of slope were also associated with primary forest degraded areas in the three provinces studied. Unfortunately, the occurrence of primary forest degradation in the case study locations could not be explained 100% by the selected direct causes. The exclusion of illegal activities such as illegal logging, illegal mining and spontaneous transmigration explained this impediment to the study.

Table V-13 shows how the rate of primary forest degradation was related to the selected variables. Primary forests at least five kilometres from transmigration villages in the three provinces studied appear to have been degraded between 2000 and 2009. The rate of degradation in these areas was 43% in South Kalimantan, 87% in East Kalimantan, and 16% in SE Sulawesi.

In South Kalimantan, the rate of forest degradation was much higher than the average of 2% in transmigration areas (43%). In East Kalimantan, a high rate of primary forest degradation (compared to the average of 16%) occurred within natural concessions (27%), industrial

plantation concessions (78%), mining sites (72%), transmigration areas (87%), flat areas (56%) and roaded areas (77%). In SE Sulawesi, the rate of degradation of the primary forest areas was higher from the overall average rate of 6% occurring in transmigration areas (16%), community-based concessions (16%), flat sites (18%) and roaded areas (31%).

c) Deforestation

Maps of deforestation were compared with maps of selected variables (see Table III-6 in Chapter 3 for a list of variables) in order to see if there was any association.

As presented in Table V-8, between 2000 and 2009, deforestation in South Kalimantan (15%) is the highest percentage of the three provinces studied. In terms of deforested area, East Kalimantan, however, has more deforestation. A total of 792,566 ha (88,000 ha/year) disappeared over the nine year period between 2000 and 2009, compared to 125,668 ha (14,000 ha per year) in South Kalimantan and 58,073 ha (6,500 ha per year) in SE Sulawesi. Figure V-20 depicts the vast majority of deforested areas occurred in secondary forests.

These deforested areas were associated with the selected variables namely forest concessions (natural concessions and industrial plantation concessions), community-based concessions, mining sites, transmigration areas, road networks and flat areas. Figure V-21 – Figure V-24 and Table V-12 show that across all three provinces studied deforestation were associated with these selected variables.

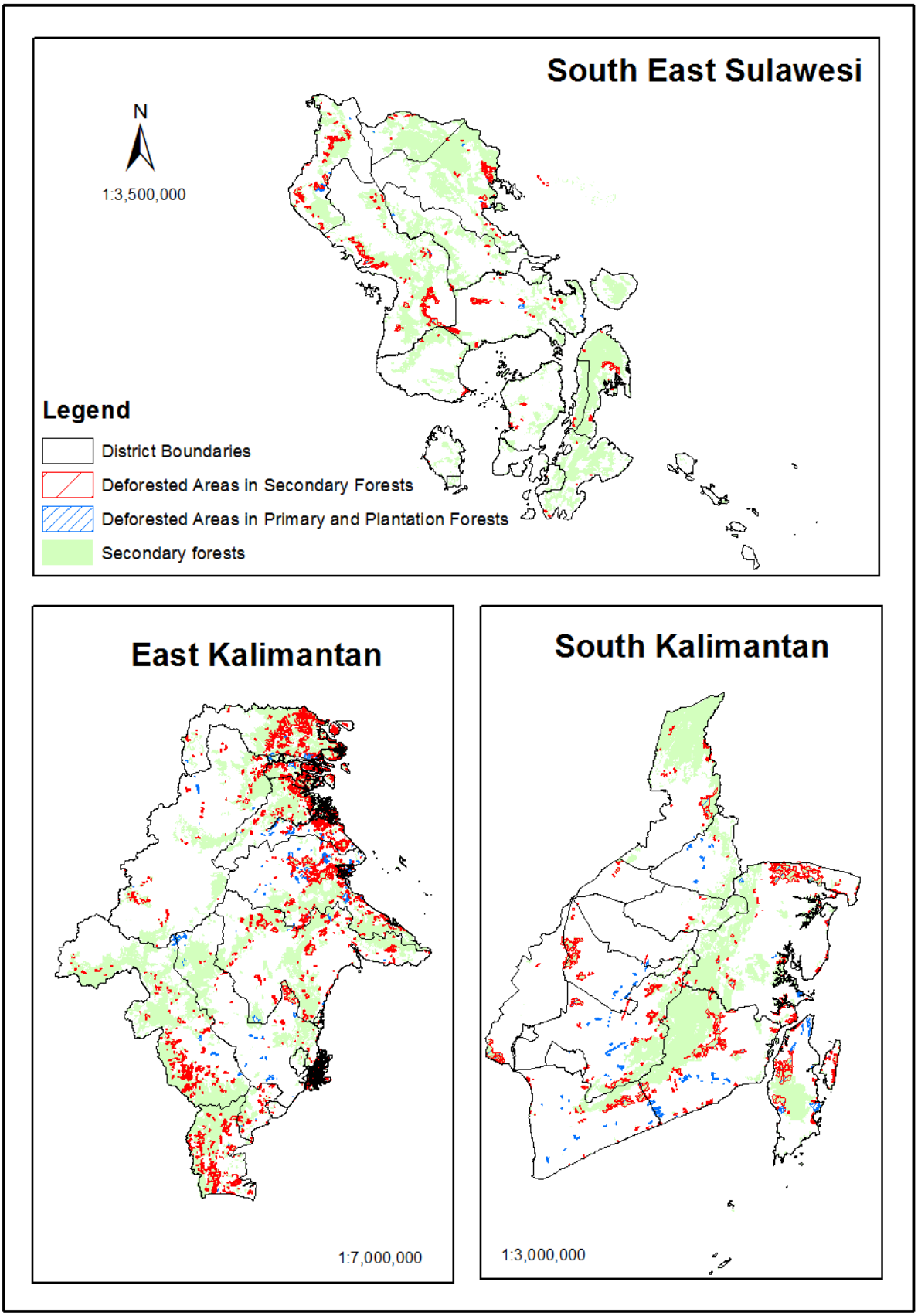


Figure V-20 Deforestation in the three provinces studied

South Kalimantan

East Kalimantan

SE Sulawesi

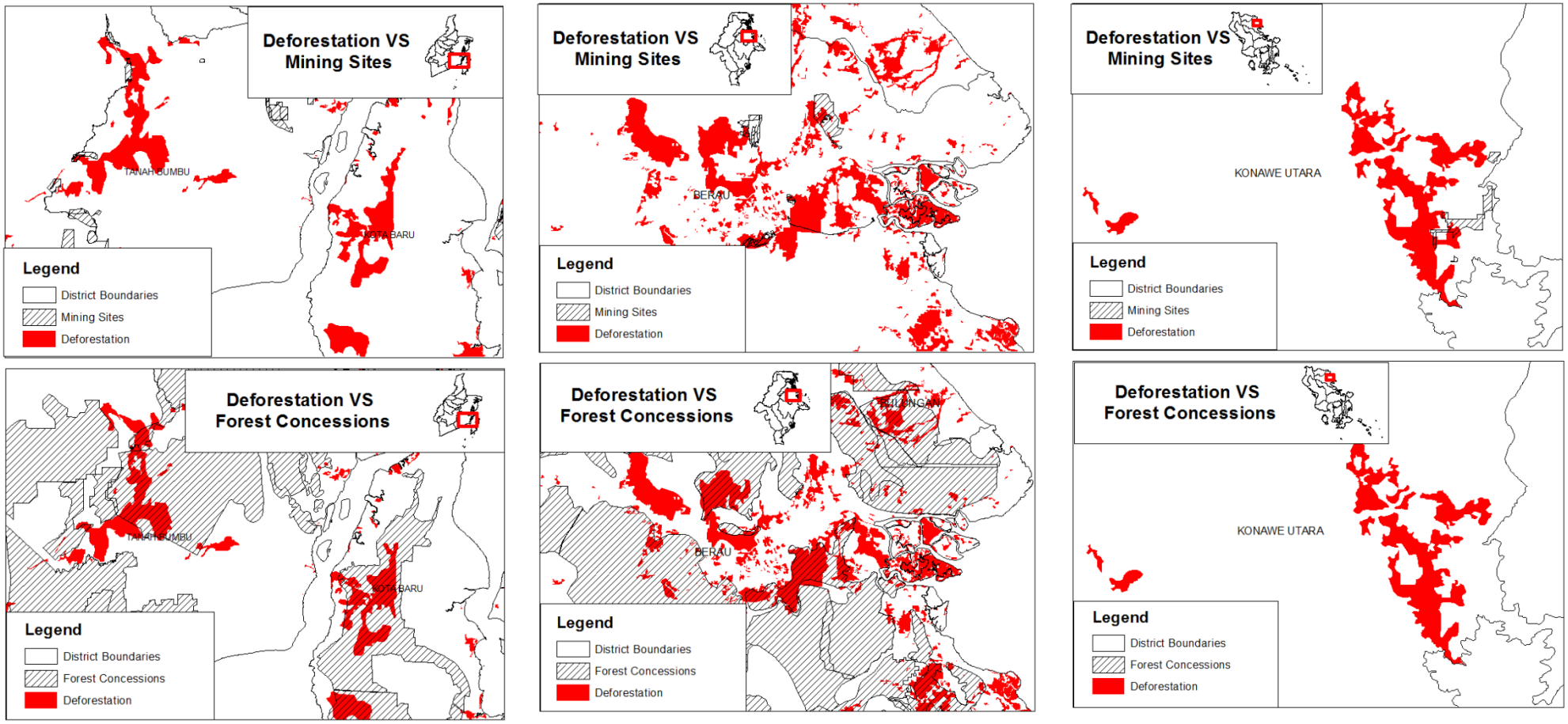


Figure V-21 Deforestation within (a) mining sites and (b) forest concessions

South Kalimantan

East Kalimantan

SE Sulawesi

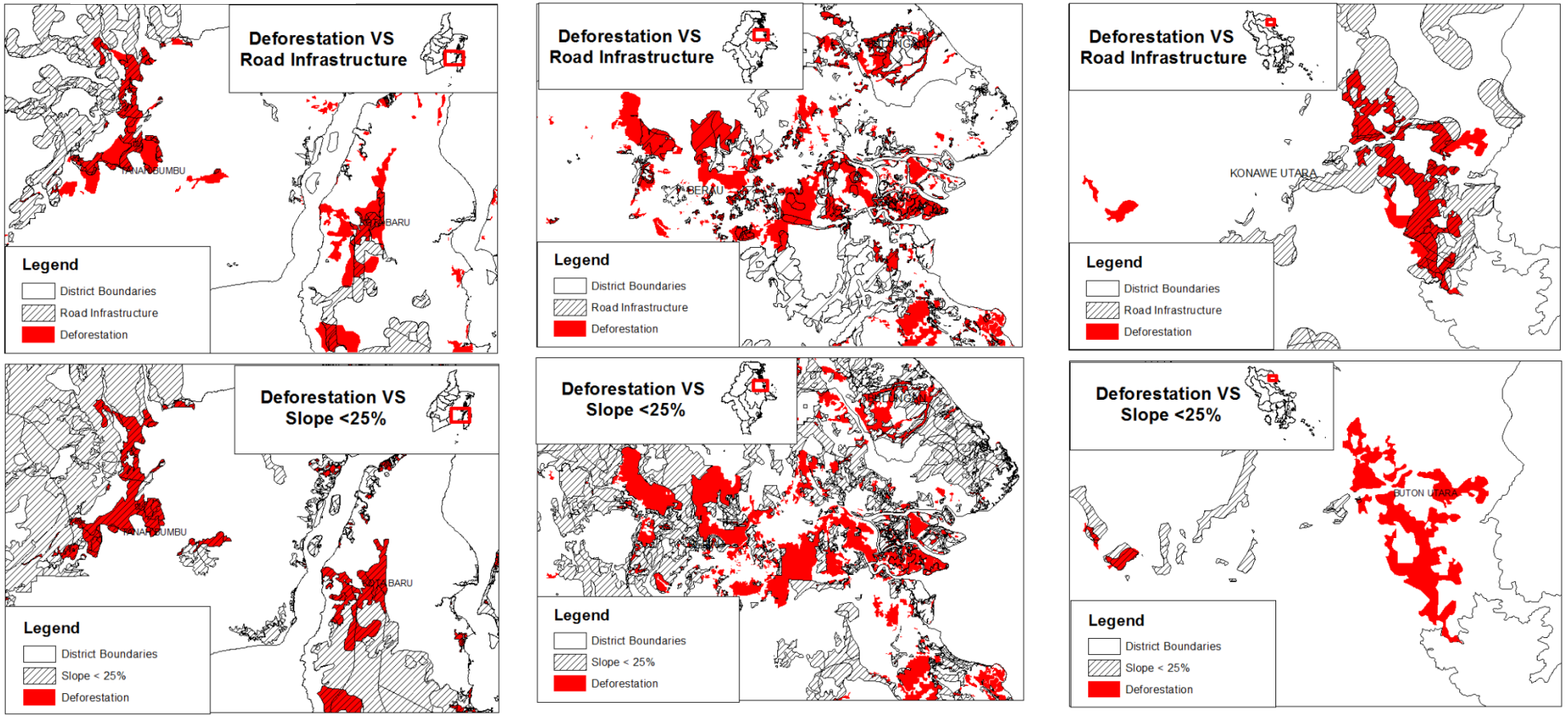


Figure V-22 Deforestation within (a) road infrastructure and (b) flat areas

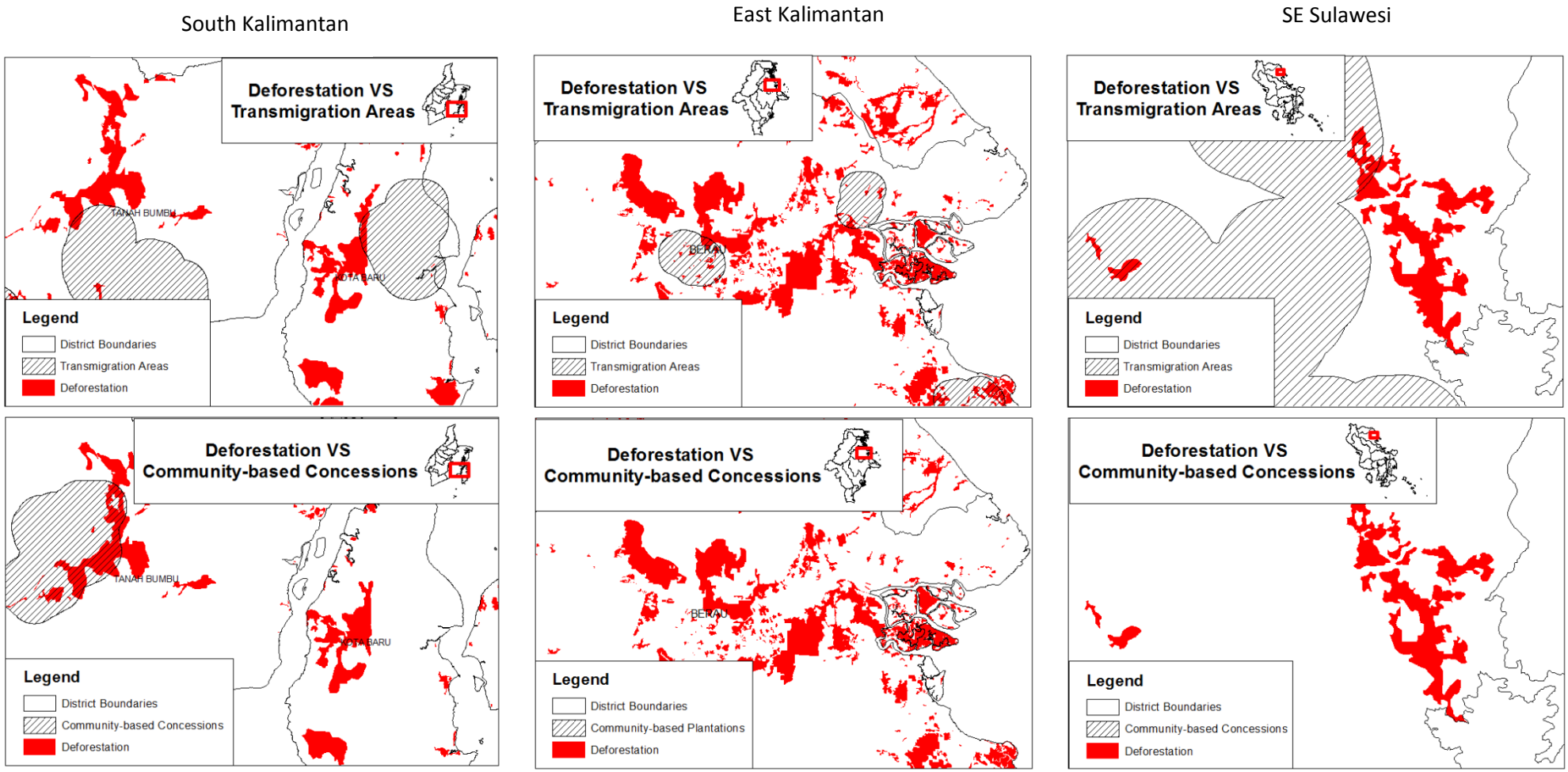


Figure V-23 Deforestation within (a) Transmigration and (b) Community-based concessions

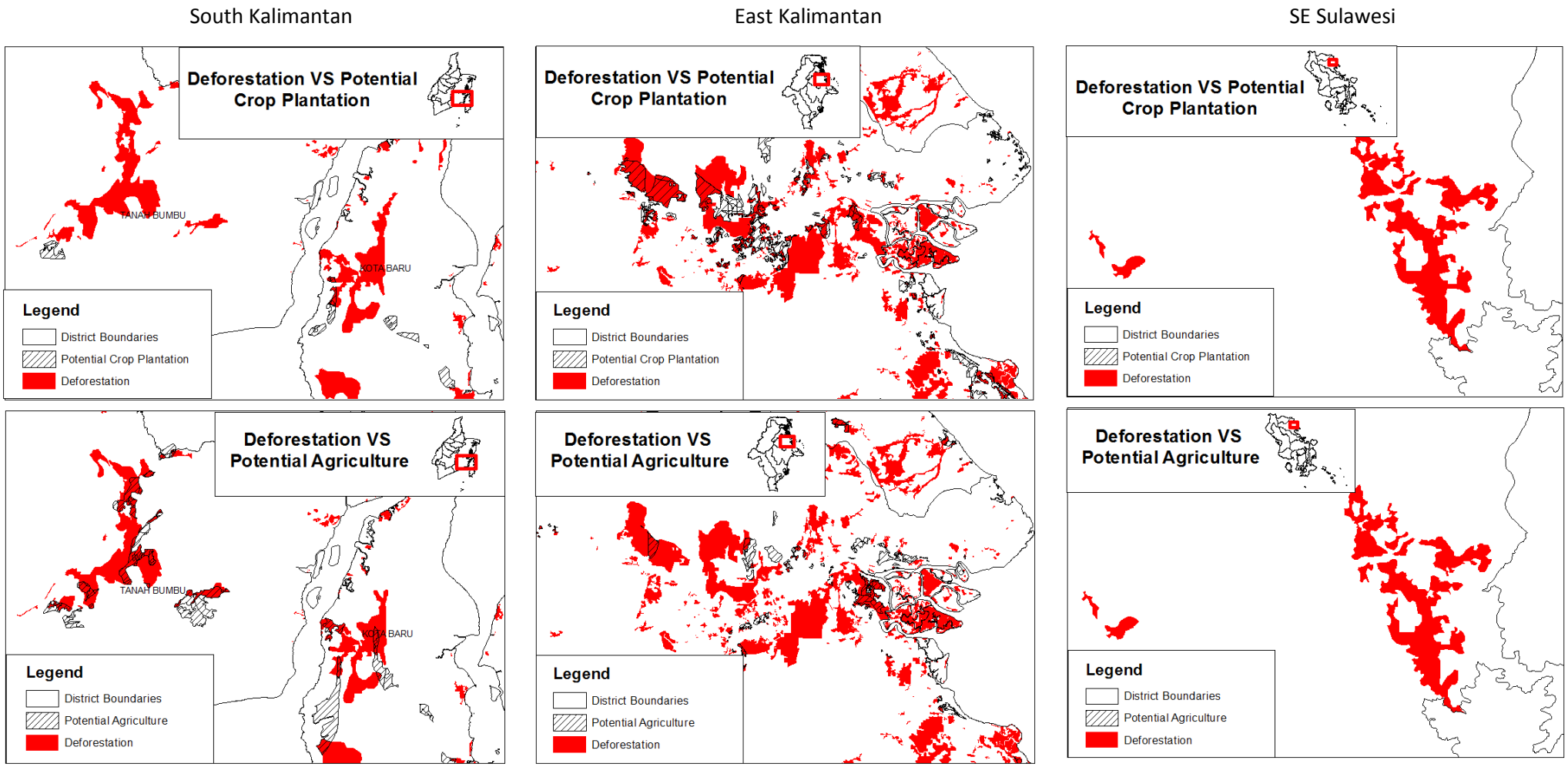


Figure V-24 Deforestation within (a) potential agriculture and (b) potential crop plantation

South Kalimantan

East Kalimantan

SE Sulawesi

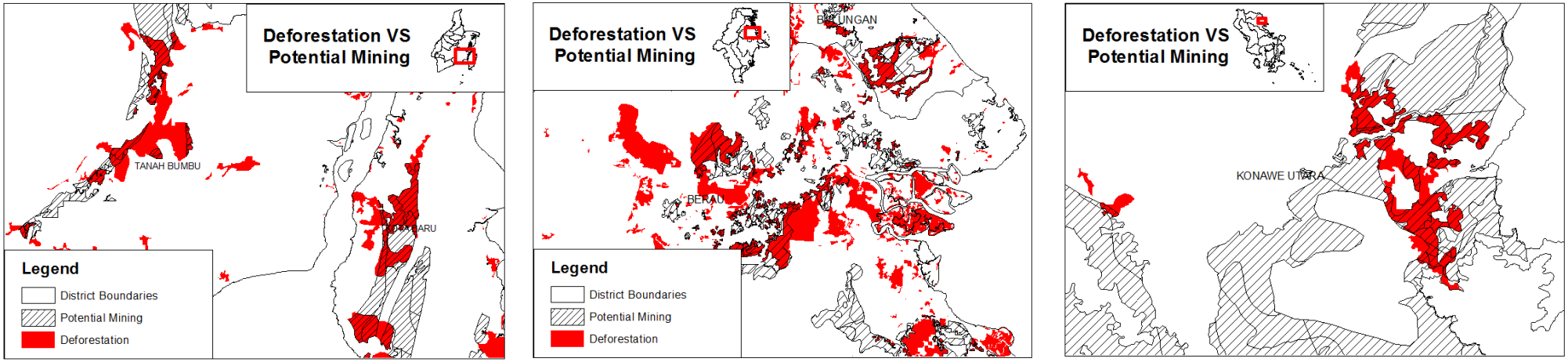


Figure V-25 Deforestation within potential mining areas

Table V-14 Proportion of secondary forest deforested areas that occurs in the categories of selected direct and underlying causes

Province	Secondary forests (Ha)	Secondary forest deforestation (Ha)	Rate of secondary forest deforestation (%)	Proportion of deforested areas in secondary forest that occurs in the categories of selected direct and underlying causes							
				Natural (Ha)	Natural (%)	Plantation (Ha)	Plantation (%)	Total forest concessions (Ha)	Total forest concessions (%)	Comm-based (Ha)	Comm-based (%)
South Kalimantan	863,089	125,668	15	14,276	11	22,632	18	36,908	30	17,830	14
East Kalimantan	6,714,791	792,566	12	166,768	21	128,722	16	295,490	37	3,032	0
SE Sulawesi	1,214,127	58.073	5	482	0	0	0	482	0	16,744	29
Province	**Secondary forests (Ha)**	**Secondary forest deforestation (Ha)**	**Rate of secondary forest deforestation (%)**	**Proportion of deforested areas in secondary forest that occurs in the categories of selected direct and underlying causes**							
				Mining sites (Ha)	Mining Sites (%)	Transmigration (Ha)	Transmigration (%)	Slope (Ha)	Slope (%)	Road (Ha)	Road (%)
South Kalimantan	863,089	125,668	15	1,442	1	14,257	11	120,453	96	32,953	26
East Kalimantan	6,714,791	792,566	12	7,777	1	47,596	6	0*	0*	394,240	50
SE Sulawesi	1,214,127	58.073	5	6,283	11	8,641	15	10,772	19	29,469	51
Province	**Secondary forests (Ha)**	**Secondary forest deforestation (Ha)**	**Rate of secondary forest deforestation (%)**	**Proportion of deforested areas in secondary forest that occurs in the categories of selected direct and underlying causes**							
				Potential mining (Ha)	Potential mining (%)	Potential agriculture (Ha)	Potential agriculture (%)	Potential crop plantation (ha)	Potential crop plantation (%)		
South Kalimantan	863,089	125,668	15	39,549	31	23,811	19	8,067	6		
East Kalimantan	6,714,791	792,566	12	344,508	43	108,729	14	161,050	20		
SE Sulawesi	1,214,127	58.073	5	6,283	11	348	1	1,680	3		

*Could not acquire the data

Table V-15 Rate of secondary forest deforestation that occurs in different categories of the selected direct and underlying causes

Province	Secondary forests (Ha)	Secondary forest deforestation (Ha)	Rate of secondary forest deforestation (%)	Rate of secondary forest deforestation in different categories of selected direct and underlying causes										
				Natural (%)	Plantation (%)	Total forest concessions (%)	Comm-based (%)	Mining sites (%)	Trans. (%)	Slope (%)	Road (%)	Potential mining (%)	Potential agriculture (%)	Potential crop plantation (%)
South Kalimantan	863,089	125,668	15	10	19	14	24	41	43	16	14	22	57	41
East Kalimantan	6,714,791	792,566	12	6	21	8	35	18	25	0*	15	13	20	27
SE Sulawesi	1,214,127	58.073	5	6	0	6	7	69	5	5	20	4	5	8

*Could not acquire the data

Table V-16 Proportion of secondary forest converted to different land uses

Province	Secondary forest deforestation (Ha)	Rate of secondary forest deforestation (%)	Proportion of secondary forest converted to different land uses									
			To Bushland (Ha)	To Bushland (%)	To Agriculture (Ha)	To Agriculture (%)	To Mining (Ha)	To Mining (%)	To Crop Plantation (Ha)	To Crop Plantation (%)	To Others (Ha)	To Others (%)
South Kalimantan	125,668	15	64,535	51	18,000	14	5,372	4	8,615	7	29,146	23
East Kalimantan	792,566	12	400,618	51	109,772	14	64,322	8	119,616	15	96,723	12
SE Sulawesi	58.073	5	22,132	38	29,016	50	4,742	8	1,214	2	969	2

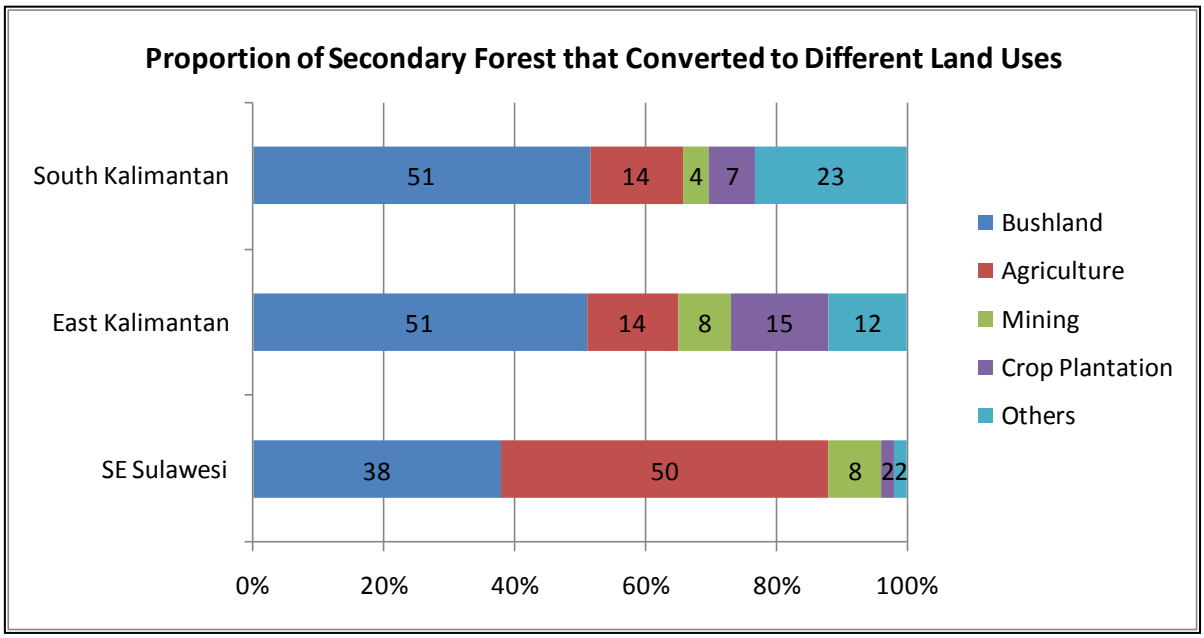


Figure V-26 Proportion of secondary forest converted to different land uses

Table V-14 shows the proportion of secondary forest deforestation that occurs in the selected direct cause activities such as forest concessions, mining sites and transmigration, as well in the selected underlying causes such as road networks and the flat areas of South Kalimantan, East Kalimantan and SE Sulawesi. Table V-15 shows the rate of deforestation within secondary forest of forest concessions, transmigration areas, mining sites, road networks and flat areas of the case study locations. For example, a total of 32,947 ha of secondary forest in South Kalimantan were located within transmigration areas. Around 14,257 ha of the area was deforested between 2000 and 2009; therefore the rate of secondary forest deforestation within the area was 43%.

Unlike forest degradation, the occurrence of deforestation in the three selected provinces in the direct cause categories was relatively low. The selected direct causes namely forest concessions, mining activities and transmigration programs were only associated with 56% of secondary forest deforestation in South Kalimantan, 44% in East Kalimantan and 55% in SE Sulawesi. Datasets of Illegal forestry activities as well as legal and illegal agricultural-based

activities such as rubber plantation, oil palm plantation and cocoa plantation were not available to this analysis.

Table V-14 shows that the highest proportion of secondary forest deforestation in South Kalimantan was associated with forest concessions (30%), followed by community-based concessions (14%) and transmigration (11%). In East Kalimantan, 37% of deforested areas occurred in forest concessions and 6% in transmigration villages, with 29% in the community-based concessions and 15% in transmigration areas in SE Sulawesi.

Table V-15 shows that between 2000 and 2009, the rate of secondary forest deforestation in South Kalimantan was higher than the average rate of 15% and occurred in industrial plantation forests (19%), community-based concessions (24%), mining sites (43%), flat areas (16%), potential mining (22%), potential agriculture (57%) and potential crop plantation (41%). In East Kalimantan, a high rate of secondary forest deforestation (compared to the average of 12%) occurred within industrial plantation concessions (21%), community-based concessions (35%), mining sites (18%), transmigration areas (25%), roaded areas (15%), potential mining (13%), potential agriculture (20%) and potential crop plantation (27%).In SE Sulawesi, the rate of deforestation of the secondary forest areas was higher than the overall average rate of 5% and occurred in natural forest concessions (6%), community-based concessions (7%), mining sites (69%), roaded areas (20%) and potential crop plantation (8%).

Table V-16 presents land use change in secondary forests of the three provinces studied. Secondary forests were converted into different land use changes and in South Kalimantan land conversion was mostly the result of the conversion of secondary forests to bush lands (51%), to other land uses (23%), and to agricultural lands (14%). In East Kalimantan, secondary forests were converted predominantly to bush land (51%), to crop plantation such as to oil palm plantations (15%), and to agriculture (14%). In SE Sulawesi, the majority of secondary forests in these provinces were converted to agricultural land (50%), to bush land (38%) and to mining (8%). Appendix I – Appendix K display land conversion from secondary forests to different land uses in the three provinces studied.

B. Empirical results

A number of explanatory variables were chosen in an attempt to explain forest degradation and deforestation, including population density, population growth, poverty, poverty growth, potential agriculture, potential mining, potential crop plantation, forest concessions, community-based concessions, transmigration areas, road infrastructure and slope. The unit of each of these variables is presented in Table III-6 in Chapter 3.

All sub-districts which have no primary forests or a primary forest area of less than 1,000 ha were excluded from the forest degradation analysis. Additionally, all sub-districts which have no secondary forests or have a secondary forest area of less than 1,000 ha were also excluded from the deforestation analysis.

Different unit measurements for degradation and deforestation: area (hectare) and percentage (%) were used to calculate the correlation coefficient. This is designed to accommodate a wide range of variation among the data, especially the different patterns of forest degradation and deforestation among sub-districts. Using percentage as a unit of measurement will matter for all sub-districts which have small forest areas and have high rates of forest degradation and deforestation; however, using area as a unit of measurement will be important for all sub-districts which have high forest areas and high rates. To show the high variation in the data, both area and percentage were used.

1. Degradation and its explanatory variables

Table V-17 presents the correlation between forest degradation and the explanatory variables for each province at the sub-district level. Sample sizes are different from province to province. The results indicate that some variables have significant correlations with forest degradation in South Kalimantan, East Kalimantan and SE Sulawesi (see Table V-17).

Table V-17 Correlation matrix of forest degradation rate and explanatory variables

Variable	South Kalimantan (n=14)		East Kalimantan (n=67)		SE Sulawesi (n=87)	
	ha	**%**	**ha**	**%**	**ha**	**%**
Population Density 2009	-	-	-.057	.015	-.051	-.017
Poverty 2009	-	-	.133	.333**	.129	.079
Forest Concessions	-	-	.520**	.334**	-.031	-.061
Community-based Con.	-	-	.483**	.422**	.157	.213*
Transmigration Areas	-	-	.256**	.247*	.325**	.229*
Road	-	-	.437**	.272*	.279**	.339**
Slope	-	-	.940**	.164	.379**	.233*
Mining Site	-	-	.227	.205	-.049	-.046

****.Correlation is significant at the 0.01 level (2-tailed).**
***.Correlation is significant at the 0.05 level (2-tailed).**

Coefficient correlation between forest degradation and explanatory variables in South Kalimantan could not be calculated as forest degradation only occurred in one district (two sub-districts) of the province.

Forest degradation rate (%) in East Kalimantan is significantly related to five variables namely poverty, forest concessions, community-based plantation, transmigration areas and road networks (see Table V-17). A positive sign is expected from these five variables since degraded areas in East Kalimantan were located predominantly within forest concessions, transmigration areas and road networks (see Table V-13 and Table V-14). The percentage of families in poverty, as expected, is correlated significantly ($r = .333$, $p < .05$) with forest degradation, even though compared to the other provinces studied, namely South Kalimantan and SE Sulawesi, East Kalimantan had the lowest poverty in 2009 (see Table V-1). As the level of poverty increases, forest degradation in East Kalimantan is likely to increase.

Based on Table V-17, there are four out of seven variables that are significantly correlated with forest degradation (%) in SE Sulawesi: community-based concessions, transmigration villages, road infrastructure and slope less than 25%. Community-based concessions, however, have no significant relationship with forest degradation in SE Sulawesi when calculating coefficient correlation using area (hectare) as a unit of measurement.

Figure V-26 – Figure V-29 show the relationship between all variables with forest degradation at the sub-district level of all three provinces studied. Unit measurement was the rate of forest degradation (%). These graphs show that despite some correlation being significant, the pattern is highly variable.

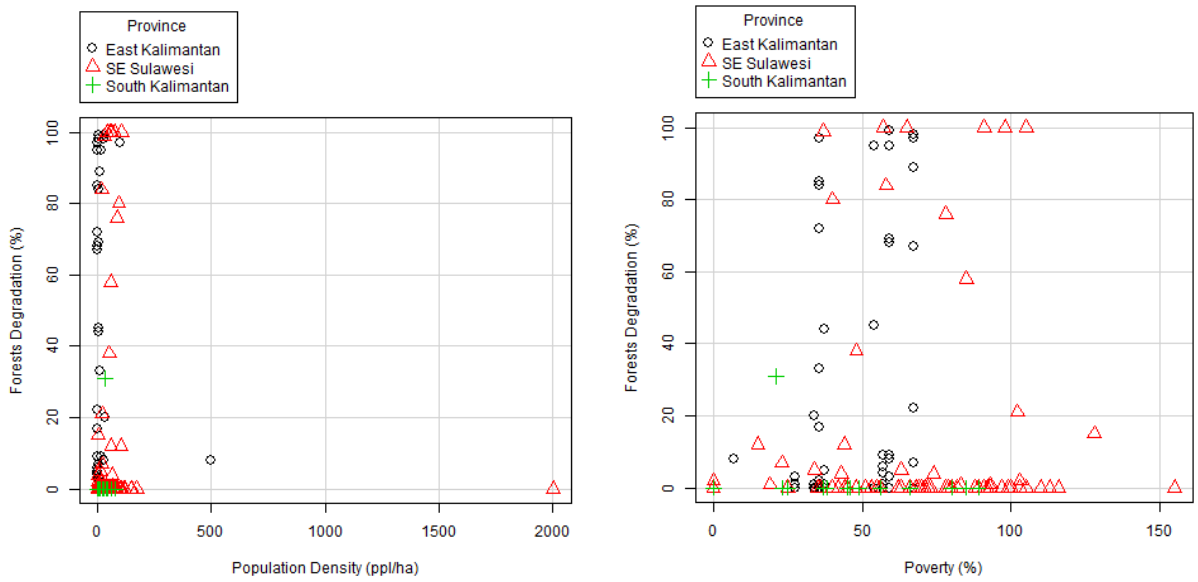


Figure V-27 (a) Population density and (b) poverty

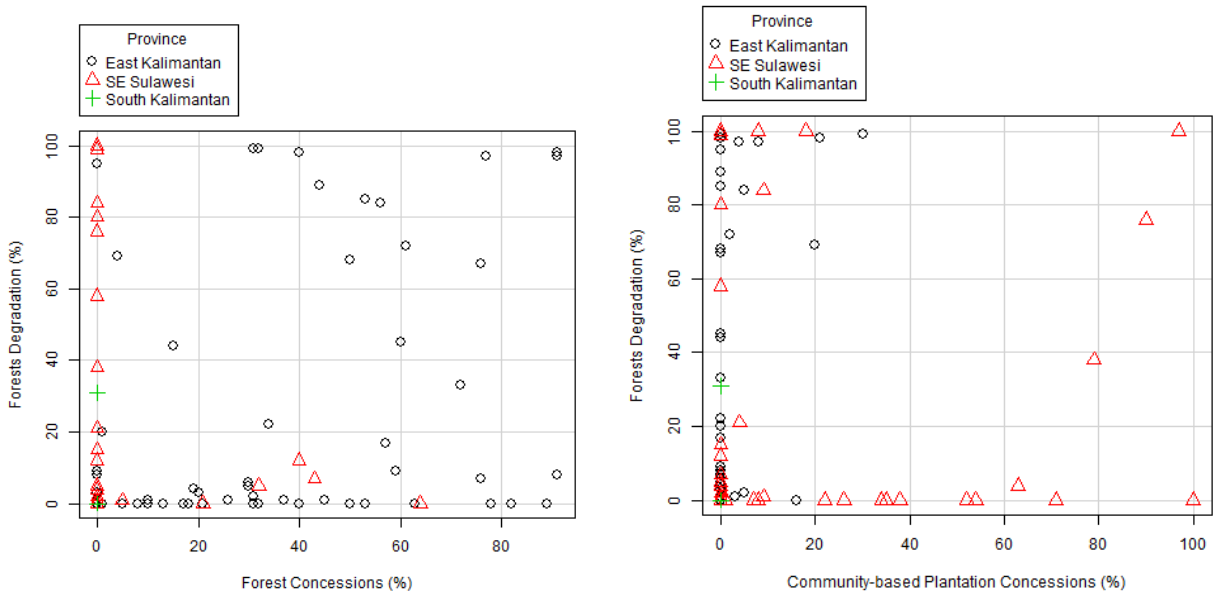


Figure V-28 (a) Forest concessions and (b) community-based plantations

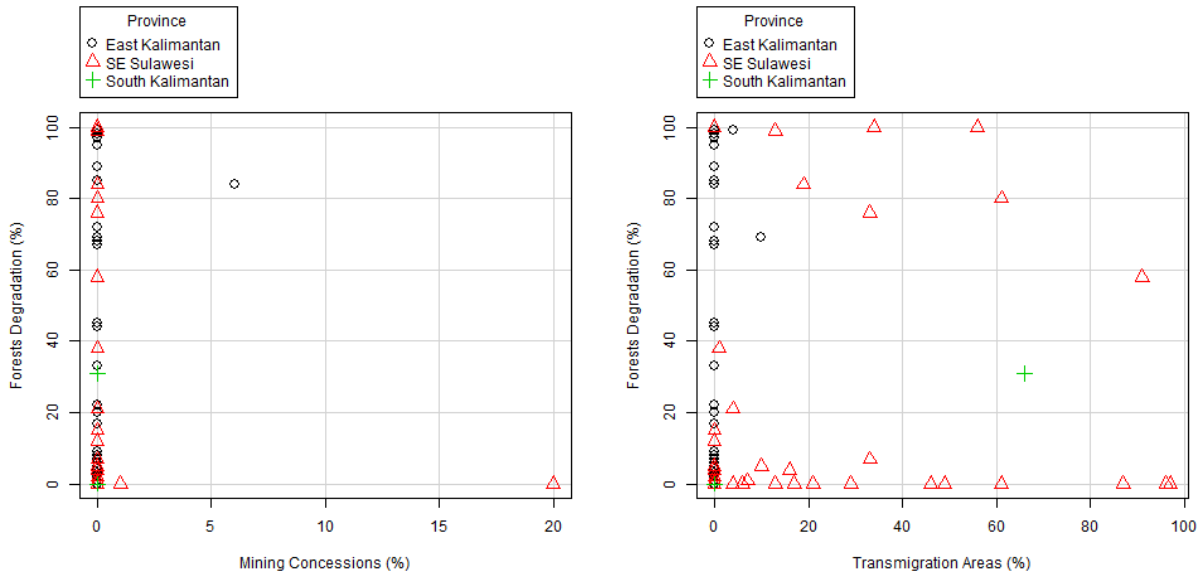


Figure V-29 (a) Mining concessions and (a) transmigration areas

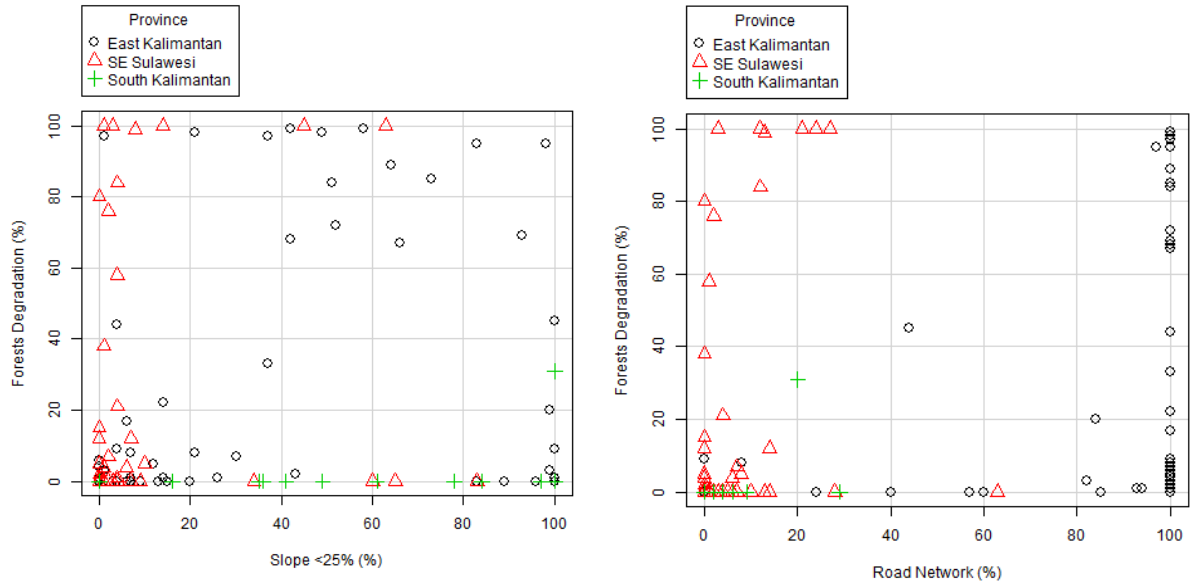


Figure V-30 (a) Slope and (b) road network

2. Deforestation and its explanatory variables

The relationships between deforestation and the independent variables are determined by calculating the Pearson's coefficient of correlation. The correlation matrix presents the relationship between land conversion and the explanatory variables for each province (provided in Table V-18).

Table V-18 Correlation matrix of deforestation and explanatory variables

Variable	South Kalimantan (n-50)		East Kalimantan (n=119)		SE Sulawesi (n=134)	
	ha	**%**	**ha**	**%**	**ha**	**%**
Population Density 2009	-.184	.249	-.171	-.091	-.047	-.023
Poverty 2009	-.039	-.052	.062	.036	-.253**	-.248**
Forest Concessions	327*	-.192	.299**	-.118	.104	.179*
Community-based Con.	.288*	-.167	-.034	-.068	.173*	-.005
Transmigration Areas	.407**	.157	-	-	.039	-.033
Road	.394**	-.010	.474**	.074	.289**	.218*
Slope	.333*	.290*	.526**	.196*	.055	-.067

Mining Sites	.258	.073	.004	-.072	.041	.024
Potential Mining	.284*	.093	.302**	.715**	.115	.024
Potential Crop Plantation	.343*	.237	.320**	.525**	.-092	-.079
Potential Agriculture	.709*	.648**	.149	-495**	-.045	-.090
****.Correlation is significant at the 0.01 level (2-tailed).**						
***.Correlation is significant at the 0.05 level (2-tailed).**						

Table V-18 shows that in South Kalimantan there are only two out of ten variables that have a significant correlation with deforestation rate (%). The variables are slope and potential agriculture. However, if dealing with area as a unit of measurement, most of the variables are significant. Forest concessions, community based-plantation concessions, transmigration settlements, road, the degree of slope, potential mining, potential crop plantation, and potential agriculture all suggest a positive and significant correlation (see Table V-22). The latter corresponds with the results in Table V-14 and Table V-15.

Table V-18 also indicates that, in East Kalimantan, variables such as slope, potential mining, potential crop plantation and potential agriculture are significantly correlated with deforestation rate (%). Surprisingly, potential agriculture is negatively correlated with land conversion, and this is totally different from expectation. It is expected that land that has potential for agricultural activities is more likely to be deforested. However, this variable has a positive relationship, but is not significant if area was used as the unit of measurement. Other variables aforementioned are positive as expected (see Table V-18). Forest concessions and roads have a positive and significant relationship with deforestation (expressed as an area) in East Kalimantan.

Deforestation in SE Sulawesi is significantly correlated with three variables among the eleven selected variables. The variables that are significant are poverty, the existence of forest concessions and road networks. Poverty and land conversion are negatively correlated (see Table V-18). Even though SE Sulawesi is among the poorest province in Indonesia, poverty is not positively correlated with deforestation. As expected, road networks has a positive relationship and is significant. Forest concessions have no correlation with deforestation in SE Sulawesi, corresponding with the result as shown in Table V-14.

Table V-18 shows that in general, deforestation has a correlation with “big actors” such as forest concessions (significant in all three provinces) and a small actor, that is local people who are involved in transmigration programs and community-based plantations (significant in SE Sulawesi). This corresponds with the results as presented in TableV-14, Table V-15, Figure V-21b, Figure V-23a and Figure V-23b.

Figure V-30 – Figure V-35show the relationship between all variables with deforestation at the sub-district level for all three provinces studied. They show that despite some correlations being significant, there are few clear trends. For example, the correlation of deforestation with potential agriculture (r = .648) is relatively high for South Kalimantan. Figure V-35b shows that the significant relationship is due to four sub-districts (out of the 50 sub-districts). Sub-districts that have high deforestation rates also have a high agricultural potential.

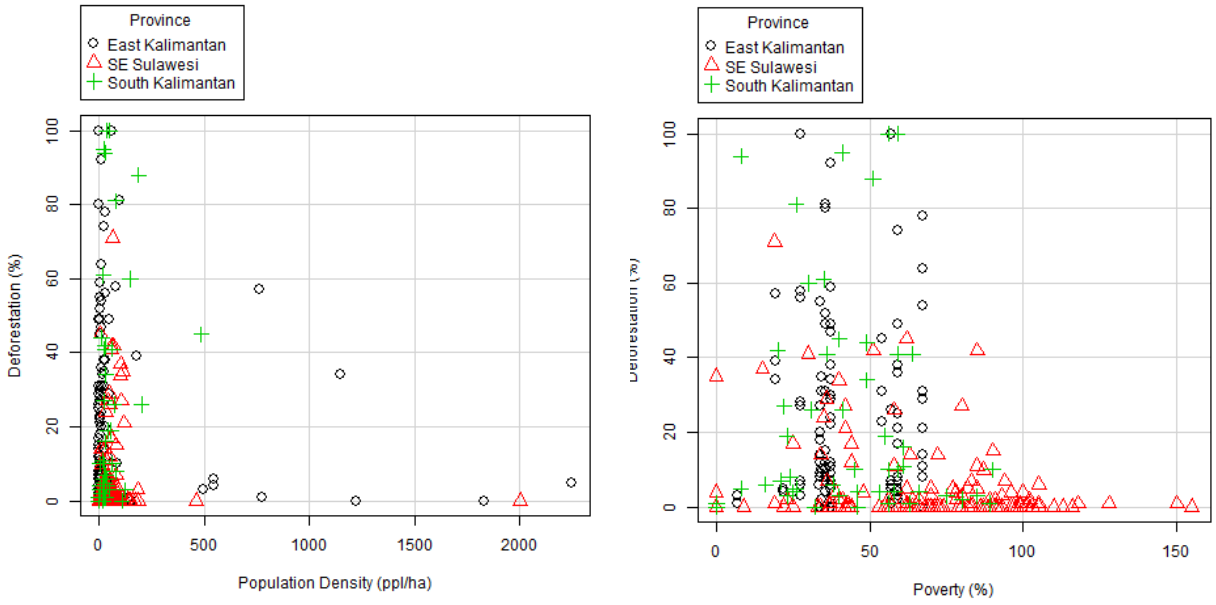


Figure V-31 (a) Population density and (b) poverty

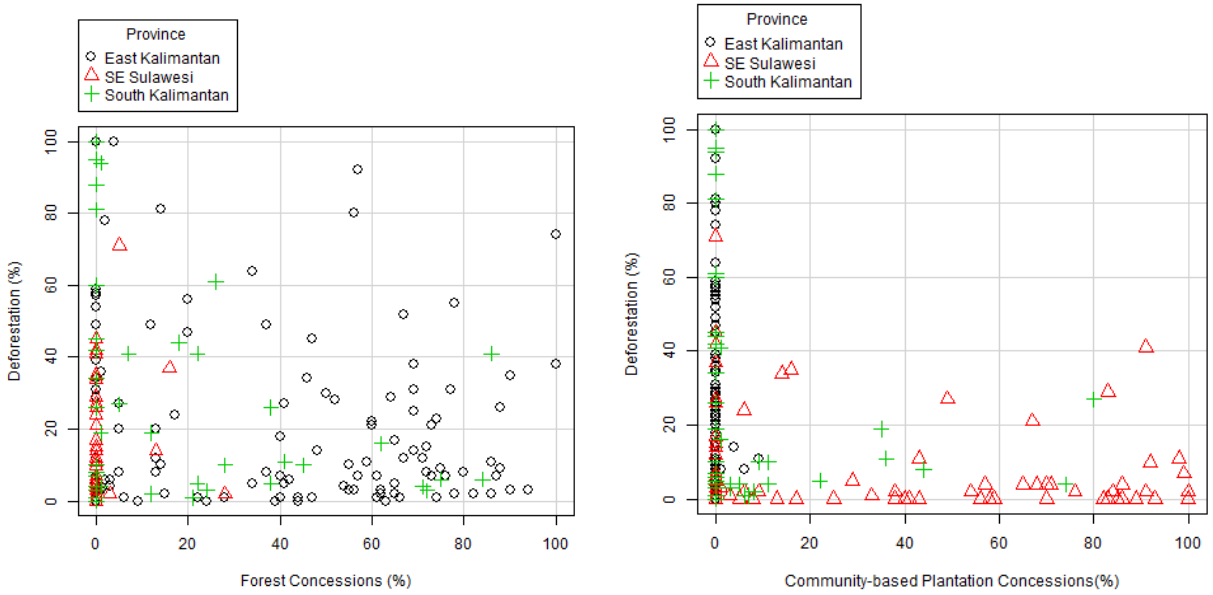


Figure V-32 (a) Forest concessions and (b) community-based plantations

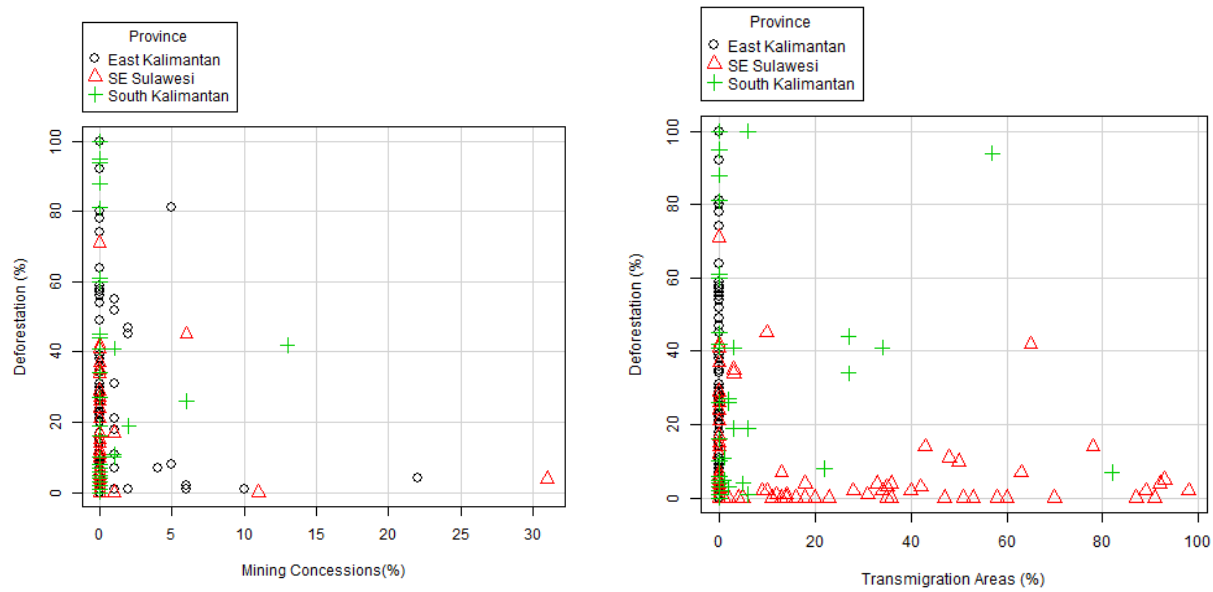


Figure V-33 (a) Mining concessions and (b) transmigration areas

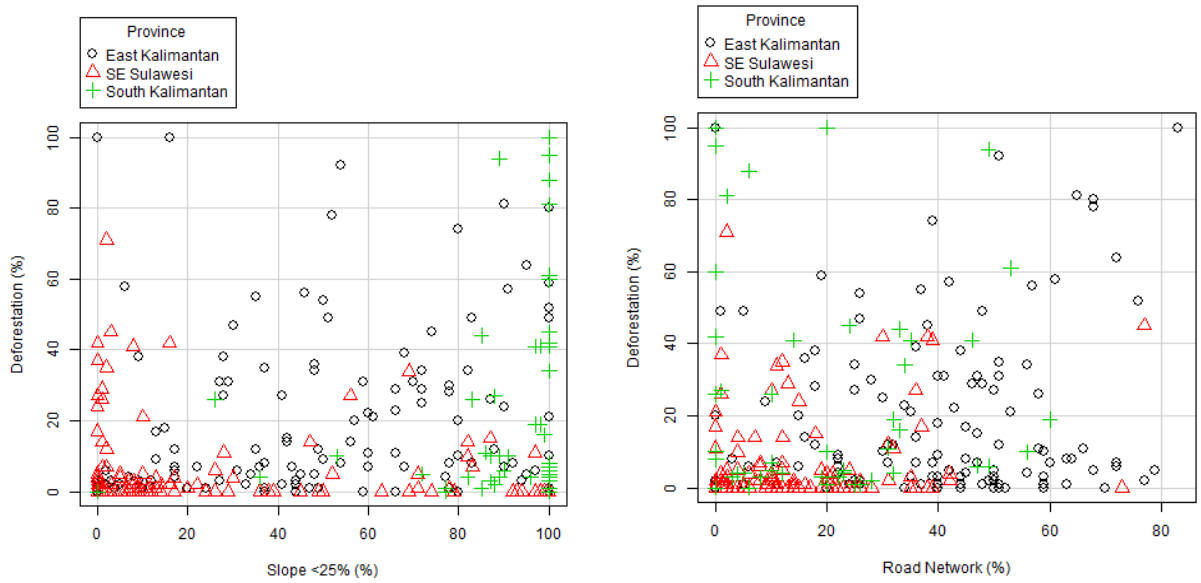


Figure V-34 (a) Slope and (b) road network

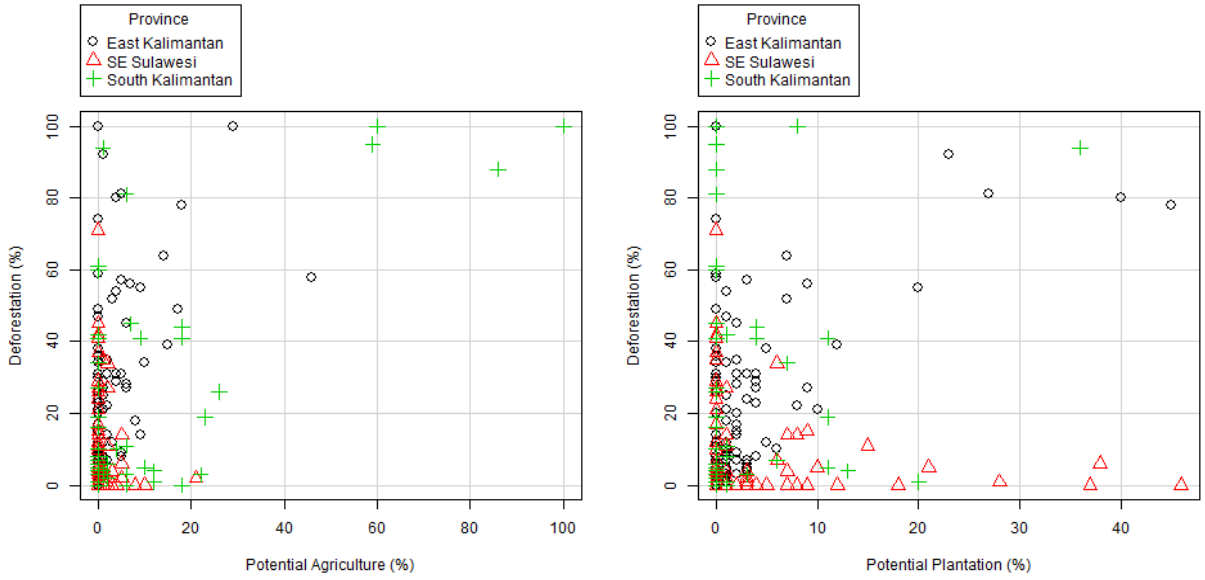


Figure V-35 (a) Potential agriculture and (b) potential plantation

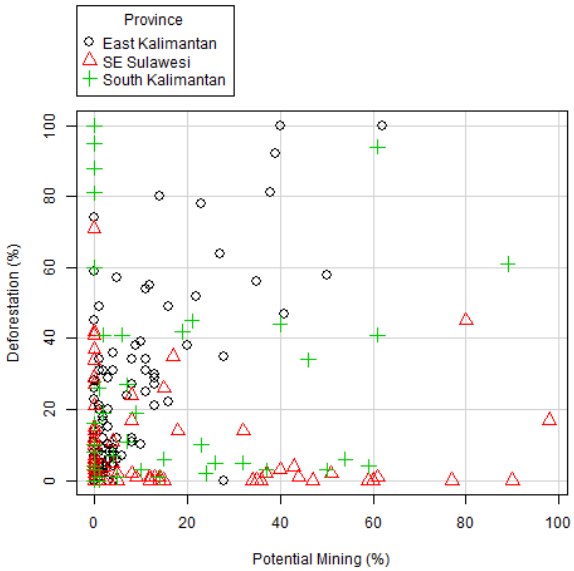


Figure V-36 Potential Mining

C. Discussion

In the past when the definitions of forest degradation and deforestation were unclear, deforestation was actually a term that also was used to describe a condition of degraded forests (Sunderlin&Resosudarmo, 1996). It was from 2000 onwards that most international organisations defined and differentiated forest degradation and deforestation clearly (Contreras-Hermosilla, 2000; IPCC, 2003; FAO, 2003a, 2003b; BAPPENAS, 2010). Although this study has several limitations, it can descriptively describe land use changes between 2000 and 2009 in South Kalimantan, East Kalimantan and SE Sulawesi. Direct causes of forest degradation and deforestation in Indonesia have been identified (Angelsen, 1995; Arunarwati & Weir, 1998; Broich, et al., 2011; Contreras-Hermosilla, 2000; Legg & Scotland, 1998; Putera, Suyanto, Widayati, Murdiyarso, & Wasrin, 1998; Sunderlin & Resosudarmo, 1996; Verchot, et al., 2010) and some causes correspond with the results of this study, although others remain unexplained. The direct causes are mostly related to commercial plantation activities, transmigration programs, infrastructure development, mining activities, commercial logging and natural forest fires.

The results of this study show that: (1) the rates of forest degradation and deforestation between 2000 and 2009 in South Kalimantan and SE Sulawesi experienced a decreasing trend when compared to the period 1990 and 2000, while the reverse is true for forest degradation and deforestation in East Kalimantan; (2) forest degradation in South Kalimantan predominantly occurred in officially non-forest areas (61%), while in East Kalimantan and SE Sulawesi it occurred in the official forest land use areas: 71% and 94% respectively. Deforestation between 2000 and 2009 mostly took place in the forest estates of the three selected provinces: 52% in South Kalimantan, 53% in East Kalimantan and 83% in SE Sulawesi; (3) human-based activities such as forest concessions, community-based forest concessions, mining activities and transmigration explained to some extent the forest degradation and deforestation in South Kalimantan, East Kalimantan and SE Sulawesi. Other physical factors such as the degree of slope, road network, and potential land for mining, crop plantation and agriculture have also explained to a degree the forest degradation and deforestation of the three provinces studied.

1. The rates of forest degradation and deforestation of the three provinces studied

Primary forest degradation between 2000 and 2009 in the three provinces studied had different rates (see Table V-9). In East Kalimantan, the province has the largest primary forest degraded areas followed by SE Sulawesi and South Kalimantan. Between the period, a total of 141 ha in South Kalimantan, 134,241 ha in East Kalimantan and 5,928 ha in SE Sulawesi of primary forests have changed into a degraded condition annually (see Table V-8).

Secondary forest deforestation between 2000 and 2009 had also different rates among the three provinces (see Table V-8). East Kalimantan has the largest deforested areas, followed by South Kalimantan and SE Sulawesi. A total of 13,966 ha, 88,397 ha and 6,452 ha of secondary forests in South Kalimantan, East Kalimantan and SE Sulawesi respectively have been converted to different land uses annually between 2000 and 2009 (see Table V-8). Secondary forests in the three provinces studied have been converted to bushland, to agricultural lands, to crop plantation, to mining and to other land uses (see Table V-16 and Figure V-26).

Actually, the rates of forest degradation and deforestation in South Kalimantan and SE Sulawesi experienced a decreasing trend, although increasing rates still occurred in East Kalimantan. This is especially true when the rates of forest degradation and deforestation in 1990 – 2000 are compared to those in the period 2000 – 2009 (see Table V-2 – Table V-7, Figure V-1 and Figure V-2). East Kalimantan has a high number of areas of primary and secondary forests that still exist. The President of Indonesia in 2012 claimed, that for the last 10 years, the deforestation rate in the country has been decreasing to a maximum of 0.5 million ha when compared to the period of 1997 – 2003 when the rate peaked at 3.5 million ha per year (BAPPENAS, 2010; Mahamel, 2012). The country's performance in decreasing the rates of forest degradation and deforestation has been acknowledged by FAO, the international organisation that is responsible for conducting global forest monitoring. FAO has recognised that Indonesia has succeeded in decreasing its forest degradation and deforestation rates (FAO, 2011). However, the national aggregation figure has concealed the high rates of forest degradation and deforestation at the provincial level, particularly in the timber-rich provinces of Indonesia.

This study confirmed that in a province like East Kalimantan, which in 2009 still had 70% of its total land in forested areas, the rates of forest degradation and deforestation have been increasing over 1990 – 2009 (see Table V-8, Figure V-1 and Figure V-2). For provinces which had forested areas of less than 55% in 2009: South Kalimantan and SE Sulawesi, the rates have been decreasing from 1990 – 2009. However, the decrease in these rates has little relationship with reforestation program that have been initiated by MoF extensively since 2001. Between 2000 and 2009, a maximum of 10,767 ha in South Kalimantan, 61,712 ha in East Kalimantan, and only 186 ha in SE Sulawesi have been reforested (see Table V-3, Table V-5, and Table V-7). This is small area when compared to degraded and deforested areas for the same period of time. Successful reforestation programs in Indonesia are not common and targets are under-achieved (Alimuddin, 2012; Korowotjeng, 2007; Noordwijk, et al., 2007; Siregar, et al., 2007). Forest resources of this country remain prone to degradation and deforestation for the next decade, especially if the GoI does not improve the performance of current intervention programs.

2. Forest degradation, deforestation and the official forest areas

This study shows that forest degradation and deforestation do not follow designated forest boundaries. Both occur in official forest estate and other utilisation areas (non-forest areas), (see Table V-10, Table V-11, Figure V-13 and Figure V-14). About 39% of degraded areas in South Kalimantan occurred in biodiversity conservation forests, 39% in East Kalimantan occurred in production forests and 57% of degraded areas in SE Sulawesi occurred in protected forests (see Table V-10). Furthermore, 29% of deforested areas in South Kalimantan and 34% in East Kalimantan occurred in production forests, while 34% in SE Sulawesi occurred within protected forests where land conversion is illegal (see Table V-11). These results also corresponding with those of Arunarwati & Weir (1998), Broich et al. (2011), and Hansen et al. (2009). Forest degradation occurred in the forest areas where timber extracting is prohibited and deforestation occurred in the designated forest areas where land conversion is also prohibited by the Forest Law 41/1999.

High rates of degradation and deforestation areas within the official forest areas of the case study locations indicate that activities which violate the Law are taking place. For instance, in Kutai National Park in East Kalimantan, illegal logging activities have increased, especially after the 1997/1998 global financial crises (Merril & Effendi, 1999 as cited in (Sunderlin, 1999). Illegal logging is beyond the scope of this study, however, Illegal exploitation of forest resources, particularly illegal logging, are a pervasive problem in Indonesia, leading to a high rates of forest degradation and deforestation (Ismail, 2007). In Indonesia, illegal logging accounts for 15% of annual timber production (Dauvergne, 1994), and 52% in 1999 alone (Telapak, 1999). Indeed, illegal and legal timber productions is almost equal (ITFMP, 1999 as cited in Sunderlin, 1999). A high rate of illegal activities within the official forest areas indicate inadequate forest monitoring takes place and that a low level of law enforcement has been implemented.

As one of the mega-diverse countries, Indonesia possesses huge forest areas (see Table I-1), however as a developing country, Indonesia has a shortage of financial resources to protect and conserve its forests. Although the forestry sector is in second place in contributing to the national revenue, misuse and mismanagement of forest resources aggravate the sustainability of the resource. The Indonesian Government has established a monitoring and safeguarding program in cooperation with central and local government: central government (MoF) has the responsibility for monitoring and safeguarding protected and conservation forests, while local government (Forest Service Office), in cooperation with central government, has the responsibility for production forests. The ratio of forest police officers (*Polisi Kehutanan – Polhut*) to the areas of forest estate to be monitored and safeguarded has been inadequate, especially for timber-rich province such as East Kalimantan (see Table IV-4).

Lack of demarcation signs on the ground to differentiate forest estate and non-forest areas and slow progress with forest establishment have triggered forest encroachment and indirectly led to high rates of forest degradation and deforestation within the official forest areas. In the three provinces studied, very few of the total assigned forest areas have been demarcated and established (see Table IV-6). Also, land tenure problems in which 52% of the official forest areas overlap with the customary land of the locals (Noordwijk, et al., 2007) have fuelled the forestry-related problems. These two issues are imperative for sustainable forest management; however, since the designation of forest estate in 1999/2000 the progress on solving land

dispute and demarcating forest estate has been slow. Clear legal status for forest land can actually reduce social conflicts over forest areas in Indonesia (Obidzinski & Dermawan, 2010). Overlapping jurisdictions among central institutions and non-synchronised policies between central and local government have also magnified forestry-related problems like forest degradation and deforestation in Indonesia.

Additionally, in the last 20 to 30 years, forest management in Indonesia has not been transformed into a better shape. MoF is responsible for managing forest resources but seems to be ineffective and inefficient in supporting a sustainable forestry sector. Regulations and policies with regard to forest management have been enacted but only on paper and there is lack of enforcement. Policies have changed nothing and are even non-existent in some areas of Indonesia (Dauvergne, 1994). Corruption, coalition and nepotism (*Korupsi, KolusidanNepostisme – KKN*) are extremely rampant in the country. KKN have defined forest management and forest practices in Indonesia for the last three decades (Kartikasari, 2008; Telapak, 1999). Conservation, forest protection and support for local livelihoods are overridden by economic goals and the political views of decision makers, who have been supported by the coalition parties of the existing government. Natural resources in Indonesia are owned by the State (The Basic Law 1945), and the entire set of ministers, who are responsible for managing the natural resources, are appointed by the current government. Most of the ministers are the heads of a political party or at least a member of the governing coalition. Any decisions and directions towards natural resource management are entirely connected to the economic and political views of the governing coalition. Without corresponding changes in the attitudes and practices, overcoming forest degradation and deforestation in Indonesia will be impossible (Dauvergne, 1994).

3. Direct and underlying causes of forest degradation and deforestation of the three selected provinces

Direct causes of forest degradation in South Kalimantan and SE Sulawesi involved small agents (transmigrants and community-based license holders), while forest degradation in East Kalimantan was more related to a combination of large and small agents such as forest concession holders and locals who participated in transmigration and community-based

concessions (Table V-12 and Table V-13). This explains a high rate of forest degradation in East Kalimantan. Deforestation in all three case studies was a combination of small and large agents (Table V-14 and Table V-15). Overall, in the three provinces studied forest degradation can be explained by direct causes: 95% in South Kalimantan, 65% in East Kalimantan, and 46% in SE Sulawesi. However, quite a low proportion of secondary forest deforestation can be explained by the selected direct causes (below 60%).

a) Transmigration program

It has been noticed from this study that the government-sponsored relocation program, or transmigration program, were significantly related to forest degradation in all three provinces (Table V-17). A high proportion of forest degradation in South Kalimantan (95%), East Kalimantan (4%) and SE Sulawesi (22%) was located within five kilometres of transmigration villages (Table V-12). The rate of primary forest degradation within transmigration areas between 2000 and 2009 was also high in all three provinces: 43% in South Kalimantan, 87% in East Kalimantan and 16% in SE Sulawesi (Table V-13).

The proportions of deforestation within transmigration areas were 11% (South Kalimantan), 6% (East Kalimantan) and 15% (SE Sulawesi) to the total secondary forest deforestation between 2000 and 2009 (Table V-14). The rate of secondary forest converted to different land uses in transmigration villages between the period was 43% in South Kalimantan, 25% in East Kalimantan and 5% in SE Sulawesi (Table V-15).

Forest degradation and deforestation attributable to transmigration were actually difficult to quantify because of the lack of data available about unassisted transmigration settlements. This study only focused on the government-sponsored transmigration programs and did not include spontaneous transmigration villages. Therefore, the figure can actually be bigger because the areas of transmigration can be up to two or three times higher when considering unassisted transmigration (Whitten, 1987).

GoI introduced regular transmigration programs back in the 1950s (Menakertrans, 2011). The selection of transmigration villages is mainly based on soil condition, the amount of available land, population density, as well as military-strategic location (national security) (Wijst, 1985).

However, since the 1990s much research has acknowledged how this government-sponsored program has contributed to forest degradation and deforestation in Indonesia (Whitten, 1987; Angelsen, 1995; Sunderlin & Resosudarmo, 1999). Unfortunately, after more than 20 years, this study has revealed that nothing has changed in relation to transmigration and forest degradation and deforestation in Indonesia, particularly in the three provinces studied. Transmigration is still related to forest degradation and deforestation in Indonesia. This is in a line with Dick's (1991 as cited in Angelsen, 1995) findings that 67% of all deforestation in Indonesia was related to government-sponsored relocation programs.

Land cover change from forest area to agricultural land is more or less related to transmigration programs as transmigration aimed at producing food crops. For every transmigrant family, about two ha of land were given to the family to establish food crops (Dick, 1991 as cited in Sunderlin & Resosudarmo, 1996; Menakertrans, 2011). However, the land provided an inadequate income to support family expenses and daily necessities (Sunderlin & Resosudarmo, 1996) because it had poor soil characteristics (Whitten, 1987). Forest degradation and deforestation caused by agricultural expansion, were actually also related to transmigration programs. Transmigrant settlers removed timber and converted forested land into agricultural land in order to survive in their new settlement areas. Sunderlin & Resosudarmo (1996) argued about the claim made by Dick (1991) who assumed that most transmigrants cleared forested land for their basic needs. The results of this study, however, correspond to Dick (1991). Forested land as far as five kilometres away from transmigration settlements was subject to forest degradation and deforestation at higher rates (Table V-13 and Table V-19).

b) Forest concessions

A high proportion of forest degradation (59%) has occurred within forest concessions, especially in the timber rich province of East Kalimantan, while only 4% occurred in forest concessions in SE Sulawesi (Table V-12). Indeed, forest concessions are significant for forest degradation in East Kalimantan. The rate of primary forest degradation in natural concessions was 27% and 78% in industrial plantation concessions (Table V-13). A high rate of primary forest degradation within the forest concessions is an indication of unsustainable practices being adopted by the license holders. In East Kalimantan, only 11% of the licence holders received a 'good' category in the Sustainable Natural Forests Management Certification Program

(*Pengelolaan Hutan Alam Produksi Lestari – PHAPL*) (Greenomics, 2013). Inadequate monitoring by the Government of Indonesia of forest concessions activities has created negative tendencies in the holders who thus do not comply with regulations.

Unsustainable practices (conventional logging) were applied by forest concession licence holders causing damage to more than 50% of the existing stands (Sist et al., 2003). In 2003, ITTO got a training program underway for forest-rich countries like Indonesia, Guyana, and Cambodia to adopt a reduced impact logging (RIL) technique. The RIL technique is designed to minimize the damage to the soil surface and to other stands because of harvesting activities (ITTO, 2008). However, for province like East Kalimantan where the density of harvestable trees is often higher than 10 trees per hectare, the RIL technique alone could not support sustainable logging practices (Sist et al., 2003).

Devastating forest fires in 1997/1998 also indirectly explained to some degree the degraded areas within forest concessions in East Kalimantan. During 1997/1998, at least 530,000 ha of primary and secondary forests of East Kalimantan were burnt and degraded because of the fires, compared to only 25,987 ha in South Kalimantan and 4,699 in SE Sulawesi (MoF, 2001, 2006, 2011). Of those in East Kalimantan, 73% were located within forest concession areas (Telapak, 1998). High areas of bushland were part of the negative impact from the devastating forest fires in 1982/1983, 1997/1998 and most recently in 2009, that affected the three provinces studied. Grassland: *alang alang* (*Imperata cylindrica*) was widespread through repeated burnings and has not been utilized and converted into more productive land uses (Siscawati, 1999; Sugardiman, 2007). This corresponds with the high proportion of degraded areas within natural concessions in East Kalimantan (50%) compared to only 9% in the area of industrial plantation concessions (Table V-12), and also in concert with a high proportion of secondary forest converted to bushland (Table V-16).

The destructive logging activities in Indonesia are difficult to control for some political reasons (Dauvergne, 1994). The underlying causes of loggers as the direct actor for forest degradation and deforestation were actually also triggered by the role of government policies (Contreras-Hermosilla, 2000), lack of monitoring and inadequate enforcement of forest laws (Barbier & Burgess, 2001). Mistaken policy interventions with regard to forest concession activities have

contributed to forest degradation and deforestation in the country. Policy interventions such as 'the selective cutting policy' and 'the reforestation fund policy' were actually underlying these destructive activities by the loggers (Dauvergne, 1994).

Similarly, the rate of deforestation which occurred within the forest concessions was also quite high, particularly in industrial plantation concessions in South Kalimantan (19%) and in East Kalimantan (21%). The rate was higher when compared to the average rate of deforestation of 15% in South Kalimantan and 12% in East Kalimantan. In SE Sulawesi, the rate of deforestation in natural concessions (6%) was also slightly higher than the average rate of 5%. Forest concessions are significant causes of deforestation in all three provinces studied (Table V-18) and this corresponds with the study of Dauvergne (1994) and Angelsen (1995). Forest concession holders are granted approval from MoF to utilize the forest areas without having the right to convert the area into non-forest areas or to other land uses. As the licence holders are granted vast concession areas, to safeguard the concessions areas from encroachments is a difficult task (Sunderlin & Resosudarmo, 1996), and MoF lacks the capacity and resources for monitoring a huge areas of forest concessions.

c) Community-based concessions

The establishment of a community-based concessions program (*Hutan Tanaman Rakyat – HTR*) in 2007 actually was actually designed for supporting conservation and forest protection activities that were supported by locals (MoF, 2007). Community-based concessions, however, are significant for forest degradation in East Kalimantan and SE Sulawesi (Table V-17). High rates of primary forest degradation (16%) occurred in HTR in SE Sulawesi and were higher than the average forest degradation of 6% (Table V-13). Although HTR is designed for the unproductive degraded land of production forests in Indonesia, HTR may contribute to additional forest degradation because significant removal of forest stands will follow the planting stage of HTR (Obidzinski & Dermawan, 2010).

Deforestation also occurred in HTR and is significant for deforestation in South Kalimantan and SE Sulawesi (Table V-18). The proportion of deforestation which occurred in HTR was 14% in South Kalimantan and 29% in SE Sulawesi (Table V-13). However, the rate of secondary forests

deforestation in HTR was quite high in South Kalimantan (24%), East Kalimantan (35%) and SE Sulawesi (7%). These rates were much higher than the average rate of deforestation of 15% in South Kalimantan, 12% in East Kalimantan and 5% in SE Sulawesi (Table V-15).HTR-related policies need to ensure the support of community subsistence needs between tree planting and the timber harvesting period. This is a crucial period when the income generated from timber resources is not yet available to support daily necessities, while the operational costs are high (Noorwijk et al., 2007; Obidzinski & Dermawan, 2010). Inadequate income will force communities to convert the nearest forested land from the allocated concessions to establish food crop plantations in order to survive.

d) Mining Activities

The rate of primary forest degradation and secondary forest deforestation in all three provinces is quite high in mining sites. Although the proportion of forest degradation and deforestation between 2000 and 2009 in mining sites in these provinces was very low (see Table V-12 and Table V-14), and mining is not significant to degradation and deforestation in all three provinces, the rate of forest degradation was 72% in East Kalimantan and the rate of deforestation was 41% in South Kalimantan and 69% in SE Sulawesi (see Table V-13 and Table V-15). These three provinces have a huge deposit of minerals. Indonesia is among the world's largest producer of thermal coal (PWC, 2010) and East Kalimantan and South Kalimantan are the main producers nationally. East Kalimantan and South Kalimantan have 51% of the national coal deposits, while SE Sulawesi has a significant nickel reserve (Fatah, 2008; MoF, 2008). Mining is significantly important for the economy of these provinces and contributed 24% to the regional GDP in South Kalimantan, 51% in East Kalimantan and 4% in SE Sulawesi (BPS, 2012). Nationally, the coal mining production figure between 1996 and 2009 increased significantly, and the same trend was true for Nickel production from 1996 to 2007, before it started to decrease (Figure II-10).

The Forestry Law 41/1999 (FL) accommodates the mining sector to operate within the official forest areas of Indonesia. It is limited to production forests (HP) for open and closed pit mining and protected forests (HL) for closed pit mining. Unfortunately, this sector contributes a significant ecological impact to the forest resources, as 30% of the mining areas are difficult and

even impossible to be restored into initial forested land use (MoF, 2008). The legal instruments to protect forest resources from forest degradation and deforestation associated with the mining sector are lacking. Central government in both institutions in response to mining (Ministry of Energy and Mineral Resources) and forestry (Ministry of Forestry), are in favor of supporting mining activities within the official forest land use. It took several years for the Indonesian Government to finalise the Government Regulations (*Peraturan Pemerintah - PP*) on the standard and procedure for rehabilitating and reclaiming of degraded mining areas in both official forest land use and non-forest land use. The Government of Indonesia enacted PP 76/2008 on the reclamation and rehabilitation of forest areas, and PP 78/2010 on the reclamation of mining areas.

Inconsistency in implementing the forest land use policy is also associated with the high rate of forest degradation and deforestation in the official forest estate. FL 41/1999 prohibits mining in the protected forests (HL) but allows implementation of a closed pit mining technique. However, in 2004 there were 13 large mining companies legally approved by the revision of the Forestry Law: Perpu 1/2004 (*Perubahan Atas Undang Undang No 41/1999: Perpu 1/2004*) which was specifically designed to allow these companies to operate an open pit mining technique in the area of protected forests (HL), the forest land use zone that can only be mined with a closed pit mining technique. Later on, GoI improved the legal status of the Perpu 1/2004 into The Law 19/2004 to secure the legal status of these 13 mining companies (Salim, 2010).

Furthermore, the new Minister of Forestry Decree (MFD) P.18/Menhut-II/2011 that replaced its predecessor MFD P.43/Menhut-II/2008 has loosened the restriction on regulating mining operations within the official forest areas. This MFD acknowledges that temporary mining licence holders conduct illegal exploitation activities. Therefore, if the GoI does not seriously take control and balance between mining activities and forest conservation activities by implementing and consistently supporting law enforcement with regard to forest land use, the existing forest resources will continue to be deforested into mining sites, and most dangerously, be degraded by the activities.

e) Physical factors (underlying causes)

With regard to the direct causes of forest degradation and deforestation, a significant portion of deforestation in the three selected provinces still remains unexplained. However, this study highlights that underlying causes: road networks and the degree of slope were associated with forest degradation. The aforementioned variables plus potential areas for mining, crop plantation and agriculture development were also associated with deforestation in the three study sites.

High rate of degradation occurred in roaded areas of East Kalimantan (77%) and in SE Sulawesi (31%) (Table V-13), while the rate of deforestation occurred within at least one kilometre from the road network (14% in South Kalimantan, 15% in East Kalimantan and 20% in SE Sulawesi) (Table V-15). The existence of road networks is significant for forest degradation in East Kalimantan and SE Sulawesi, and for deforestation in all three provinces studied. The results of this study is correspond with the work conducted by Contreras-Hermosilla (2000) that; for every one kilometre of access to the forest, around 400 and 2000 hectares of forest areas will be deforested, and by Arunarwati & Weir (1998); that 81% of deforested areas in the central part of Sumatera were located in a radius of one kilometre from the road networks. Deforested areas decrease as the distance from the road increases.

In all three selected provinces, the road network is important to give easy access to forest areas of the provinces. Logging activities need access to the impenetrable forest areas and on one hand road provides the solution, while; on the other hand, a road gives access to not only legal loggers, but also to illegal loggers, settlers, farmers, ranchers and miners reaching the remote forest areas. In Amazon rainforest areas, road construction has been blamed as the main agent of deforestation (Maki, Kalliola & Vurinen, 2001). About 74% of deforested areas in the Amazonia were located 50 kilometres from roads. In Nepal, road construction was the primary cause of the conversion of forested land to farmlands (Bhattarai, 2009). Forest degradation and deforestation correspond with accessibility to forest areas.

In two provinces of the case study: South Kalimantan and East Kalimantan, where river transportation is one of the major means of transport, it is not necessarily degraded and deforested areas that will correspond with the location of the hydrological system. Further

distance analysis is needed to relate forest degradation and deforestation locations with the river stream. Forest encroachment usually follows the river stream where river transport is the biggest transport facility existing (Arunarwati & Weir, 1998).

The degree of slope is also correlated with forest degradation and deforestation in the three provinces chosen. The proportion of forest degradation occurring in flat sites was 100% in South Kalimantan, 50% in East Kalimantan and 12% in SE Sulawesi (Table V-12), while the proportion of deforestation was 96% in South Kalimantan and 19% in SE Sulawesi (Table V-15). Unfortunately, the study failed to quantify deforestation in relation to the degree of slope that was less than 25% in East Kalimantan (see Table V-14, Table V-15, and Table V-18). The degree of slope is one of the important variables to be included in any forest degradation and deforestation model. The explanatory power of this variable for forest degradation and deforestation remains strong in explaining the land use change preferences in relation to degraded and deforested areas (Bhattarai, 2009).

The rates of degradation occurring in flat areas were much higher than the average degradation; 3% of 2% in South Kalimantan, 56% of 16% in East Kalimantan and 18% of 6% in SE Sulawesi (Table V-13), while the rates of deforestation occurring in flat sites were slightly higher with the average deforestation in South Kalimantan 16% of 15% and the same rate for deforestation in SE Sulawesi (5%) (see Table V-15). Geographically, 49% of the area of SE Sulawesi is hilly and mountainously (BPS, 2012), therefore flat areas in the province are likely to be degraded and deforested. In South Kalimantan, where most of the areas are flat, the area of primary forest left is very small compared to the large number of primary forests in East Kalimantan, where most of the primary forested areas lies on rugged hills and in mountainous areas (Figure V-4 and Figure V-6). Intuitively, there is a strong tendency to clear and convert forest on flat land rather than steep slopes. Between 1990 and 1995, 80% of forest cleared in Jambi Province, Indonesia was located in flat areas (Legg & Scotland, 1998). Flat areas are also the preferred lands for deforestation in Nepal (Bhattarai, 2009).

Potential agriculture, potential mining and potential crop plantation are also among other variables that have association with deforestation in South Kalimantan, East Kalimantan and SE Sulawesi (Table V-14 and Table V-15).The rates of deforestation occurring in potential mining sites were 22% in South Kalimantan, 13% in East Kalimantan and 4% in SE Sulawesi. The rates of

deforestation occurring in potential agriculture and crop plantations were 57% and 41% in South Kalimantan, 20% and 27% in East Kalimantan and 5% and 8% in SE Sulawesi respectively. Potential mining, potential agriculture and potential crop plantation are significant for deforestation in South Kalimantan and East Kalimantan, while none of these variables are significant to deforestation in SE Sulawesi (Table V-18).The limitation of this study is that potential agriculture and crop plantation areas do not cover the official forest areas of the study sites. There is a possibility that deforested areas located within the potential agriculture and crop plantations are larger than this study found (Table V-18). The coefficient correlation is probably significant in all three provinces studied as expected; high potential of agriculture and crop plantation development on a land increases the likelihood of it being degraded and deforested.

D. Summary of the chapter

A total of 1,269 ha (2%) of primary forest in South Kalimantan were degraded into secondary forest between 2000 and 2009, 1,208,167 ha (16%) in East Kalimantan and 53,357 ha (6%) in SE Sulawesi. For the same period, secondary forests in these three provinces: 125,669 ha (15%) in South Kalimantan, 792,566 ha (12%) in East Kalimantan and 58,072 ha (5%) in SE Sulawesi, were converted into different land uses. Mainly secondary forests were converted into bushlands, agriculture, crop plantation, mining and other land uses.

Between 2000 and 2009 forest degradation and deforestation were associated with the official forest areas. Forest degradation in South Kalimantan predominantly occurred in officially non-forest areas (61%), while in East Kalimantan and SE Sulawesi it occurred in the official forest areas: 71% and 94% respectively. For the same period, 2000 to 2009, 52% of deforestation in South Kalimantan, 53% in East Kalimantan and 83% in SE Sulawesi occurred in the official forest estates.

Direct causes were associated with forest degradation and deforestation in the study site locations. Around 95% of forest degradation occurred in transmigration in South Kalimantan and 22% in SE Sulawesi, while almost 60% of forest degradation occurred in forest concessions in East Kalimantan. Deforestation occurred 30% and 37% in forest concessions of South

Kalimantan and East Kalimantan respectively, while 29% of deforestation in SE Sulawesi occurred in community-based concessions.

Underlying causes were also associated with forest degradation and deforestation in the three selected provinces. All of the degraded areas in South Kalimantan occurred on flat areas (100%), while 49% and 13% of degraded areas in East Kalimantan and SE Sulawesi occurred on roaded areas. Furthermore, 96% of deforestation in South Kalimantan occurred on flat areas, 43% of deforestation in East Kalimantan occurred in the potential mining land, and 51% of deforestation in SE Sulawesi occurred on roaded areas.

VI. Conclusions and Recommendations

The objectives of this thesis were to quantify the rates of forest degradation and deforestation between 2000 and 2009 in South Kalimantan, East Kalimantan and SE Sulawesi, three provinces in Indonesia; to compare forest degradation and deforestation with the official forest areas of the three selected provinces and to quantify and to relate forest degradation and deforestation to selected direct and underlying causes. By employing a geographic information system (GIS) and calculating coefficient correlation between variables, the rates could be quantified. How much degraded and deforested areas occurred within the official forest land use zones could also be quantified, as well as the correlation between forest degradation and deforestation with the selected direct and underlying causes. The conclusions of this thesis and the implications for future research based on the results will be drawn in this final chapter. Then, recommendations to the Government of Indonesia (GoI), especially to the Indonesian forestry authorities, will also be presented.

1. The rates of forest degradation and deforestation

The rates of forest degradation and deforestation from 2000 to 2009 varied among the three provinces studied. East Kalimantan has high rates of forest degradation and deforestation compared to South Kalimantan and SE Sulawesi. In South Kalimantan and SE Sulawesi the rates of forest degradation and deforestation decreased from 1990 to 2009. However, in the timber-rich province of East Kalimantan, where 70% of the area is still forested, the rates of forest degradation and degradation increased between 1990 and 2009. From this, it can be inferred that although for the last 10 years the national rates of forest degradation and deforestation decreased (Mahamel, 2012), the decreasing trend was highly related to the total forested land left rather than to reforestation programs that have been implemented by the Government of Indonesia. In East Kalimantan the total area of reforestation between 2000 and 2009 was 61,712 ha compared to 1,729,741 ha of net forest loss. In South Kalimantan, the total area of reforestation was 10,767 ha compared to 119,433 ha of the total forest loss for the same period. Furthermore, in SE Sulawesi between 2000 and 2009 the total area of reforestation was only 186 ha compared to 60,646 of the net deforestation.

2. Forest degradation and deforestation within the official forest land use zones

This thesis revealed that degraded and deforested areas in the three selected provinces between 2000 and 2009 occurred in the official forest land use zones. It is now understood that effective forest management in Indonesia is lacking: forest degradation occurred in the official forest areas where logging activities are prohibited, and the same is true for deforestation which occurs in the forest estate zones where land conversions are totally banned. Of forest degradation in South Kalimantan 39% occurred in the conservation forests (*Hutan Konservasi – HSAW*), 39% occurred in the production forests (*Hutan Produksi – HP*) of East Kalimantan and 57% occurred in the protected forests (*Hutan Lindung – HL*) of SE Sulawesi. With regard to deforestation, 29% occurs in production forests (HP) in South Kalimantan, 34% in production forests (HP) in East Kalimantan and 34% in protected forests (HL) of SE Sulawesi. These facts indicate that forest concession holders adopt unsustainable practices and illegal activities occur without control. The government, meanwhile, employs ineffective monitoring and safeguarding programs, does not enforce forest land use policy, and is slow in establishing the designated forest areas. This means that the rate of forest degradation and deforestation of Indonesian forest resources is likely to be high, especially for the timber-rich provinces of the country.

3. Forest degradation and deforestation with its selected direct and underlying causes

This study has successfully quantified the proportion each of the selected direct and underlying causes to forest degradation and deforestation in the three provinces studied, as well as determined the rate of primary forest degradation and secondary forest deforestation in the different categories. This study has also evaluated the relationship of these selected variables with forest degradation and deforestation. The results of this study show that direct causes (forest concessions, transmigration, community-based plantation) were associated with forest degradation and deforestation in the case study locations. The study also presented the underlying causes (infrastructure development: road, the degree of slope, and potential land

for mining, agriculture and crop plantation) in support of direct causes also being associated with the high rates of forest degradation and deforestation.

In all three case study locations, most degradation is of primary forests degraded into secondary forests, while deforestation is secondary forests deforested into different land uses including bushlands, agriculture and crop plantation. The dynamics of forest degradation and deforestation in South Kalimantan, East Kalimantan and SE Sulawesi are different. Overall, 95% of forest degradation and 56% of deforestation in South Kalimantan; 65% of forest degradation and 44% of deforestation in East Kalimantan; and 46% of forest degradation and 55% of deforestation in SE Sulawesi are associated with human-related activities. Other factors remain unexplained. This is because this study was designed to analyse geographic datasets of activities such as forest concessions, regular transmigration programs, community-based plantations and mining sites, and only took into account all legal activities. Illegal activities such as illegal logging, spontaneous transmigration, swidden and shifting agricultures and illegal mining were not included as these activities were difficult to monitor and inadequate datasets are available for analyses.

In South Kalimantan, degradation occurred predominantly in transmigration areas. Secondary forests in this province were mainly converted into bushland, agriculture and crop plantation. In East Kalimantan, most degradation occurred in forest concessions. The largest amount of secondary forests of this province was converted into bushland, followed by crop plantation and agriculture. In SE Sulawesi, degradation mostly occurred within the range of five kilometres from transmigration villages and community-based plantation concessions. Unlike South Kalimantan and East Kalimantan, secondary forests in SE Sulawesi were mainly converted into agriculture, followed by bushland and mining.

Underlying causes especially road infrastructure and the degree of slope could explain the trend of forest degradation and deforestation in these three selected provinces. Like Brazil which also has high rates of forest degradation and deforestation related to road infrastructure (Maki, Kalliola & Vurinen, 2001), road networks also affected forest degradation and deforestation in Indonesia, particularly in the three provinces studied. Between 6% and 49% of

forest degradation and between 26 and 51% of deforestation in the case study locations occurred at least one kilometre from road networks. Access to the remote forest areas that was first designed to provide easy access for forestry related activities in support of economic development, in turn however has contributed to forest degradation and deforestation.

B. Implications for Future Research

This study provides an insight into forest degradation and deforestation in South Kalimantan, East Kalimantan, and SE Sulawesi. Some limitations, however, prevented quantification to fully reveal the linkage between forest degradation and deforestation and their direct and underlying causes. Further studies are highly recommended in order to improve the general level of clarity on and the understanding of forest degradation and deforestation in Indonesia:

1. Further study of 'in depth policy research' is needed as forest degradation and deforestation are very much linked to the government's land use policy. This study did not cover land use policy in detail, although the results indicated that effective forest management in Indonesia is lacking; mistaken policy intervention does exist and poor monitoring and lack of enforcement of forest resource policy are the main underlying causes of the high rates of forest degradation and deforestation in Indonesia. In depth policy study and analysis are required to examine and to mitigate land use related policy that is ineffective and inefficient in supporting sustainable forestry management in Indonesia, and to formulate effective policy reform for halting forest degradation and deforestation in Indonesia. This 'in depth policy study' needs to involve central and local governments, especially with the central goverment dealing with land use management.

2. Further study in combining qualitative and quantitative approaches is also needed because forest degradation and deforestation involve big and small actors. A qualitative approach is needed in order to interpret, to understand, to make sense of social contexts and to measure locals' perspective on transmigration and community-based forestry (*Hutan Tanaman Rakyat – HTR*) with regard to forest degradation and deforestation. This study revealed that after 20 years and even more, transmigration has been and is still associated with forest degradation and deforestation, particularly in the case study locations. This

study did not include qualitative measures in trying to explain why, in some sub-districts, the rates of forest degradation and deforestation are different. Some sub-districts have high rates and others have low rates, although transmigration and HTR exist in those sub-districts.

3. Finally, further analysis of the linkage between the rates of forest degradation and deforestation with the area of forest resources of each province is needed because this study revealed that the two provinces that have forested land below 50% have a decreasing trend in forest degradation and deforestation, but the one province which has forested areas of more than 70% still has an increasing rate. A further study needs to be carried out at least involving more provinces which have forested land ranges from less than 25%, between 25% - 50%, between 50% - 75%, and more than 75% in order to predict the likelihood of forest degradation and deforestation. This study would predict the threshold of forested land that is likely to accelerate or lessen forest degradation and deforestation rates in Indonesia. The information is needed for the Government of Indonesia (GoI) to prioritise extension program targeting to provinces which have high forest resources and high rates, or low forest resources and high rates, in order to efficiently manage the forest resources of the country.

C. Recommendation for the Indonesian Forestry Authorities

Having presented the analysis on forest degradation and deforestation in the three provinces: South Kalimantan, East Kalimantan, and SE Sulawesi, the following recommendations are made to Indonesian forestry (central and local authorities):

1. To synchronise forestry-related policies at all levels which promote consistent and sustainable forest management.
2. To strengthen monitoring and safeguarding programs. This will discourage any illegal operations within forest areas, and will encourage sustainable practices from legal operators.

3. To accelerate the establishment of forest estate areas and the settlement of land tenure problems.
4. To consistently enforce forest land use policy and to halt corruption, coalition and nepotism practices (*Korupsi, Kolusi dan Nepotisme – KKN*) that are embedded in the forestry sector.
5. In order to mitigate forest degradation and deforestation in a more thorough assessment, there is a need for adequate data on illegal operations (illegal logging, spontaneous transmigration, illegal mining, and illegal land conversion) to be made available and to be valid and up to date. Remote sensing applications can be used to support the need.

VII. References

Alimuddin. (2012). Keberhasilan Penghijauan Hutan Rakyat Masih Rendah. Medan, Indonesia: Analisa Daily.

Angelsen, A. (1995). Shifting Cultivation and "Deforestation": A Study from Indonesia. *World Development, 23*(10), 1713 - 1729.

Arunarwati, B., Hussin, Y. A., & Weir, M. (1997). Detecting Tropical Deforestation Using Satellite Radar Data: A Case Study from Central Sumatra, Indonesia Retrieved 18 May, 2011, from http://www.geospatialworld.net/index.php?option=com_content&view=article&id=15277%3Adetecting-tropical-deforestation-using-satellite-radar-data-a-case-study-from-central-sumatra-indonesia&catid=124%3Aenvironment-conservation-monitoring&Itemid=41

Arunarwati, B., & Weir, M. J. C. (1998). Spatial Analysis of Deforestation in Central Part of Sumatera. In Y. Laumonier, B. King, C. Legg & K. Rennolls (Eds.), *Data Management and Modelling Using Remote Sensing and GIS for Tropical Forest Land Inventory*. Jakarta, Indonesia: Rodeo International.

Baines, G., & Hendro, M. (2006) Biodiversity Planning in Asia: International Centre for Environmental Management. Retrieved from http://www.icem.com.au/documents/biodiversity/bioplan/indonesia.pdf.

Bakosurtanal. (2012). Jumlah Pulau Berkurang. Retrieved from http://www.bakosurtanal.go.id/bakosurtanal/jumlah-pulau-berkurang

Banyan. (2012). Indonesian Forests and REDD. Palming Off. *The Economist*. Retrieved from http://www.economist.com/blogs/banyan/2012/12/indonesias-forests-and-redd

BAPPENAS. (2005). Indonesia Population Projection. Jakarta: BPS, BAPPENAS and UNPF.

BAPPENAS. (2010). Draft Strategy Nasional REDD+. Jakarta: Badan Perencanaan Pembangunan Nasional (BAPPENAS).

Barber, C. V. (2002). Forests, Fires, and Confrontation in Indonesia. Retrieved 5 January 2013, from IISD http://www.iisd.org/pdf/2002/envsec_conserving_2.pdf

Barbier, E. B., & Burgess, J. C. (2001). The Economics of Tropical Deforestation. *Journal of Economic Surveys, 15*(3), 413 - 433.

Barr, C. (2001). *Banking on Sustainability: Structural Adjustment and Forestry Reform in Post-Suharto Indonesia*. Bogor, Indonesia: WWF and CIFOR.

Barraclough, S. L., & Ghimire, K. B. (2000). *Agricultural Expansion and Tropical Deforestation*. London: Earthscan Publications Ltd.

Bhattarai, K. (2009). *Determinants of Deforestation in Nepal's Central Development Centre.* pHD, University of Missoury, Warrensburg. Retrieved from https://docs.google.com/viewer?a=v&q=cache:7GRfyD-KiwkJ:ejournals.unm.edu/index.php/nsc/article/download/660/757+deforestation+and+flat+areas&hl=en&gl=nz&pid=bl&srcid=ADGEESh5a7raeMUb3RimelBqRQ8BeBrBACY-YRCsT7IQIuYtVcrvp9Iw5fvAaYaxgF91s_unV4Csg8ZIe7PoQTF9-9_5c2BZK0FUrRcQU002OgOYuzsvoZs6D_6P73CzYoWbZjA2D0Xm&sig=AHIEtbRlao_F3N8MwqRsX24cpmJWNWDe4w

BKKBN. (2011). Profil Hasil Pendataan Keluarga Tahun 2010. Jakarta: Badan Kependudukan dan Keluarga Berencana Nasional (BKKBN).

BPS. (2000a). *Statistical Year Book of Indonesia 2000*. Jakarta, Indonesia: Badan Pusat Statistik Nasional.

BPS. (2000b). Statistical Year Book of Indonesia 2000. Jakarta, Indonesia: Badan Pusat Statistik.

BPS. (2010). *Statistical Year Book of Indonesia 2010*. Jakarta, Indonesia: Badan Pusat Statistik Nasional.

BPS. (2012a). Indonesia Population by Province in 1971, 1980, 1990, 2000, and 2010. Jakarta, Indonesia: Badan Pusat Statistik.

BPS. (2012b). Indonesian Oil Palm Statistics 2011. Jakarta, Indonesia: Badan Pusat Statistik.

BPS. (2012c). Indonesian Population Growth by Province. Jakarta, Indonesia: Badan Pusat Statistik.

BPS. (2012d). *Kalimantan Selatan in Figures 2011*. Banjarmasin, Indonesia: Badan Pusat Statistik Provinsi Kalimantan Selatan.

BPS. (2012e). *Kalimantan Timur in Figures 2011*. Samarinda, Indonesia: Badan Pusat Statistik Provinsi Kalimantan Timur.

BPS. (2012f). *SE Sulawesi in Figures 2011*. Kendari, Indonesia: Badan Pusat Statistik Provinsi Sulawesi Tenggara.

Broich, M., Hansen, M. C., Potapov, P., Adusei, B., Lindquist, E., & Stehman, S. V. (2011). Time-Series Analysis of Multi-Resolution Optical Imagery for Quantifying Forest Cover Loss in Sumatra and Kalimantan, Indonesia. *INternational Journal of Applied Earth Observation and Geoinformation, 13*, 277 - 291.

Butler, R. A., Koh, L. P., & Gazoul, J. (2009). REDD in the Red: Palm Oil Could Undermine Carbon Payment Schemes. *Conservation Letters, 2*(2).

Butt, S., & Nottage, L. (2012). Divestment of Foreign Mining Interests Set to Hurt Indonesia. *The Jakarta Globe*.

Casson, A., & Obidzinski, K. (2002). From New Order to Regional Autonomy: Shifting Dynamics of 'Illegal' Logging in Kalimantan, Indonesia. *World Development, 30*(12), 2133 - 2151.

Colfer, & Resosudarmo, D. P. (2002). Which Way Forward? People, Forest and Policy Making in Indonesia. Washington DC: Resources for the Future, Centre for International Forestry Research (CIFOR) and Institute of Southeast Asian Studies.

Contreras-Hermosilla, A. (2000). The Underlying Causes of Forest Decline. Bogor, Indonesia: Centre for International Forestry Research.

Dauvergne, P. (1994). The Politics of Deforestation in Indonesia. *Pacific Affairs, 66*(4), 497 - 518.

DNPI. (2011). The Indonesian REDD+ Strategy. Jakarta, Indonesia: Climate Change National Council (DNPI).

Erasmi, S., Twele, A., Ardiansyah, M., Malik, A., & Kappas, M. (2004). Mapping Deforestation and Land Cover Conversion at the Rainforest Margin in Central Sulawesi, Indonesia. *EARSel eProceedings, 3*(3), 388 - 397.

FAO. (2000). The Global Forest Resources Assessment. Rome, Italy: Food and Agricultural Organization of the United Nations.

FAO. (2003a). Definitions of Deforestation, from http://www.fao.org/docrep/009/j9345e/j9345e07.htm

FAO. (2003b). Definitions of Forest Degradation from http://www.fao.org/docrep/009/j9345e/j9345e08.htm

FAO. (2005). The Global Forest Resources Assessment. Rome, Italy: Food and Agricultural Organization of the United Nations.

FAO. (2010). The Global Forest Resources Assessment Report Rome: Food and Agriculture Organization of the United Nations.

FAO. (2011). State of the World's Forests. Rome: Food and Agriculture Organization of the United Nations.

Fatah, L. (2008). The Impacts of Coal Mining on the Economy and Environment of South Kalimantan Province, Indonesia. *ASEAN Economic Bulletin, 25*(1), 85 - 98.

Fogarty, D. (2011). Special Report: How Indonesia Hurts its Climate Change Project. *Reuters*. Retrieved from http://www.reuters.com/article/2011/08/16/us-indonesia-carbon-idUSTRE77F0IK20110816

Gao, Y., Skutsch, M., Masera, O., & Pacheco, P. (2011). A global analysis of deforestation to biofuel development (Vol. Working Paper 68). Bogor, Indonesia: Centre for International Forestry Research (CIFOR).

Geist, H., & Lambin, E. (2002). Proximate Causes and Underlying Driving Forces of Tropical Deforestation. *Bioscience, 52*(2), 143 - 150.

Global Forest Watch. (2010). Indonesia's Forests in Brief Retrieved 1 June, 2011, from http://www.globalforestwatch.org/english/indonesia/forests.htm

Greenomics. (2013). Kinerja HPH di Kalimantan Buruk. *KOMPAS*.

Hansen, M. C., Stehman, S. V., Potapov, P. V., Arunarwati, B., Stolle, F., & Pittman, K. (2009). Quantifying Changes in The Rates of Forest Clearing in INdonesia from 1990 to 2005 using Remotely Sensed Data Sets. *Environmental Research Letters, 4*, 1 - 12.

Harmantyo, D. (2011). *Desentralisasi, Otonomi, Pemekaran Daerah dan Pola Pemerakaran Wilayah di Indonesia* Paper presented at the National Seminar on Indonesia Conprehensive Development, Bali, Indonesia.

Harris, N. L., Brown, S., Hagen, S. C., Saachi, S. S., Petrova, S., Salas, W., . . . Lotsch, A. (2012). Baseline Map of Carbon Emissionsfrom Deforestation in Tropical Regions. *Science, 336*, 1573 - 1576.

Indonesian Rainforest Foundation. (2012). Rainforest Damage. Retrieved from http://www.indonesianrainforest.org/indonesian-rainforest/rainforest-damage.html

Iskandar, D. (2011). *The Decision Making Process in the Adoption of Agroforestry Technology by Smallholders Rubber Farmers in Indonesia.* pHD, University of Canterbury, Christchurch, New Zealand.

Ismail, S. M. (2007). Fighting Illegal Logging in Indonesia. *ITTO - Tropical Forest 17*(1), 14 - 16.

Kartikasari, S. N. (2008). *Your Biodiversity in my Backyard: Key Local Stakeholders Perception of Biodiversity Conservation in Gorontalo, Indonesia* pHD, Lincoln University, Christchurch, New Zealand.

Kirana, C. (2012a). Moratorium After A Year: Coordination For Governance Improvement Increasingly Strengthen. Jakarta, Indonesia: President's Delivery Unit for Development Monitoring and Oversight (UKP4).

Kirana, C. (2012b). A Year After Moratorium: Boosting Coordination for Forest Management Improvement. Jakarta, Indonesia: President's Delivery Unit for Development Monitoring and Oversight (UKP4).

Koh, L. P., & Butler, R. A. (2007). Can REDD Make Natural Forests Competitive with Oil Palm? *ITTO - Tropical Forest, 19*(1).

Korowotjeng, B. S. (2007). *Persentase Tumbuh Tanaman Reboisasi di Hutan Lindung Wosi Rendani, DAS Maruni, Kabupaten Manokwari.* Bachelor of Forestry, Papua University, Manokwari, Indonesia.

Legg, C., & Scotland, N. (1998). Modelling Deforestation in Western Jambi Province, Indonesia. In Y. Laimonier, B. King, C. Legg & K. Rennolls (Eds.), *Data Management and Modelling Using Remote Sensing and GIS for Tropical Forest Land Inventory*. Jakarta, Indonesia: Rodeo International.

MacKinnon, K., Hatta, G., Halim, H., & Magalik, A. (1996). *The Ecology of Kalimantan (Indonesian Borneo)* (Vol. III). Singapore: Periplus Edition (HK) Ltd.

Madeira, E. M., Sils, E., Brockhaus, M., Verchot, L., & Kanninen, M. (2011). What is a REDD+ Pilot? A Preliminary Typology Based on Early Actions in Indonesia. *CIFOR infobrief, 38*(July 2011).

Mahamel, A. (2012). Moratorium Izin Pengelolaan Hutan Kurangi Deforestasi. Retrieved from http://www.voaindonesia.com/content/moratorium-izin-pengelolaan-hutan-kurangi-deforestasi/1210883.html

Mahatma, Y. (2012). Menhut Ingin Moratorium Pengelolaan Hutan Diperpanjang. Retrieved from http://www.antaranews.com/berita/349465/menhut-ingin-moratorium-pengelolaan-hutan-diperpanjang

McCarthy, J. F. (2000). Wild Logging: the Rise and Fall of Logging Networks and Biodiversity Conservation Project on Sumatera's Rainforest Frontier. Bogor, Indonesia: Centre for International Forestry Research.

Menakertrans. (2011). Menakertrans: Tahun 2011 Kawasan Transmigrasi Sumbang 5.87 juta ton Beras. Jakarta, Indonesia: Menteri Negara Tenaga Kerja and Transmigrasi (Menakertrans).

Ministry of Domestic Affairs. (2012). Kode dan Data Wilayah Administrasi Pemerintahan Per Provinsi, Kabupaten/Kota dan Kecamatan Seluruh Indonesia. Jakarta, Indonesia.

Mittermeier, R. A., Mittermeier, C. G., & Gil, P. R. (2004). *Megadiversity: Earth's Biologically Wealthiest Nations*: Cemex.

MoDA. (2011). Presidential Instruction on Moratorium on Natural Forests and Peatlands *Inpres 10/2011*. Jakarta, Indonesia: Ministry of Domestic Affairs, Indonesia.

MoF. (2001). Forestry Statistics of Indonesia 2001. Jakarta: Ministry of Forestry.

MoF. (2004). Pedoman Pembuatan Tanaman Reboisasi Hutan Lindung dan Hutan Produksi. Gerakan Nasional Rehabilitasi Hutan dan Lahan. Jakarta, Indonesia: Ministry of Forestry.

MoF. (2006). Forest Areas for Industrial Plantation Forests Establishment *P.61/Menhut-II/2006*: Ministry of Forestry.

MoF. (2007). The Mechanism of Application for Community-based Plantation *Permenhut 55/Menhut-II/2011*. Indonesia.

MoF. (2008a). Forest Resources Inventory Program Jakarta, Indonesia: Ministry of Forestry.

MoF. (2008b). The Indonesia Forestry Statistic 2007. Jakarta: The Ministry of Forestry.

MoF. (2008c). Indonesian Forest Climate Alliance (IFCA) Consolidation Report. Reducing Emissions from Deforestation and Forest Degradation in Indonesia. Jakarta: Forestry Research and Development Agency (FORDA), The Ministry of Forestry Indonesia.

MoF. (2009a). Data Identifikasi Kawasan Hutan Produksi yang Tidak Dibebani Izin di 26 Provinsi untuk Investasi HPH, HTI, RE, HHBK and IUPJL Tahun 2010 - 2014. Jakarta: The Ministry of Forestry.

MoF. (2009b). The Mechanism for Silvopasture Concession *P.63/Menhut-II/2009*: Ministry of Forestry.

MoF. (2009c). Program Sertifikasi Pengelolaan Hutan Produksi Lestari (PHPL). Jakarta, Indonesia: Ministry of Forestry.

MoF. (2009d). Upaya Pengendalian Perubahan Iklim dan Pemanasan Global dengan One Man One Tree. Jakarta, Indonesia: Ministry of Forestry.

MoF. (2011a). Data Release Direktorat Jenderal Bina Usaha Kehutanan Triwulan II Tahun 2011. Jakarta: The Ministry of Forestry.

MoF. (2011b). The Indonesia Forestry Statistic 2011. Jakarta: The Ministry of Forestry.

Murdiyarso, D., Dewi, S., Lawrence, D., & Seymour, F. (2012). Indonesia's Forest Moratorium. Bogor, Indonesia: Centre of International Forestry Research.

Murdiyarso, D., Skutsch, M., Guariguata, M., Kanninen, M., Luttrell, C., Verweij, P., & Stella, O. (2008). Mesuring and Monitoring Forestr Degradation for REDD. *CIFOR infobrief, 16*(November 2008).

Myers, N., Mittermeier, R. A., Mittermeier, C. G., Fonseca, G. A. B. d., & Kent, J. (2000). Biodiversity Hotspots for Conservative Priorities. *Nature, 403*, 853 - 858.

Noordwijk, M. v., Suyanto, S., Budidarsono, S., Sakuntaladewi, N., Roshetko, J. M., Tata, H. L., . . . Fay, C. (2007). Is HTR a New Paradigm in Community-based Tree Planting in Indonesia? Bogor, Indonesia: World Agroforestry Centre.

O'Sullivan, D., & Unwin, D. (2010). *Geographic Information Analysis* (Vol. Second Edition). New Jersey: John Wiley & Sons Inc.

Obidzinski, K., & Dermawan, A. (2010). Smallholder timber plantation development in Indonesia: What is Preventing Progress. *Intrenational Forestry Review, 12*(4), 339 - 348.

Ormsby, T., Napoleon, E., Burke, R., Groessl, C., & Bowden, L. (2010). *Getting to Know ArcGIS Desktop, Updated for ArcGIS 10* (Vol. Third Edition). Redlands, California: ESRI Press.

Pemerintah Provinsi Kalimantan Selatan. (2010). Dinas Kehutanan Dalam Angka 2010. Banjarbaru: Dinas Kehutanan Provinsi Kalimantan Selatan.

Pemerintah Provinsi Kalimantan Timur. (2010). Dinas Kehutanan Dalam Angka 2010. Samarinda: Dinas Kehutanan Provinsi Kalimantan Timur.

Pemerintah Provinsi Sulawesi Tenggara. (2011). Dinas Kehutanan Dalam Angka 2010. Kendari: Dinas Kehutanan Provinsi Sulawesi Tenggara.

PERHUTANI. (2011). Hutan, Tanah, Air untuk Masa Depan, from http://perumperhutani.com/

Price Waterhouse Coopers. (2010). Mining in Indonesia; Investment and Taxaxion Guide Jakarta, Indonesia: Price Waterhouse Coopers.

Purnamasari, R. (2008). *Deforestation in Indoneisa: A Household Level Analysis of the Role of Forest Income Dependence and Poverty.* The University of Melbourne, Melbourne.

Putera, A. E., Suyanto, D. A., Widayati, A., Murdiyarso, D., & Wasrin, U. R. (1998). Human Population Dynamics as a Driving Factor in Land-ues Change Pattern: Initial Results from Two Study Sites in Jambi, Sumatera. In Y. Laumonier, B. King, C. Legg & K. Rennolls (Eds.), *Data Management and Modelling Using Remote Sensing and GIS for Tropical Forest Land Inventory*. Jakarta: Rodeo International.

R Core Team. (2012). R: A Language and Environment for Statistical Computing, from http://www.R-project.org

REDD-I. (2012a). Demonstration Activity Plots Retrieved 7 January, 2013, from http://www.redd-indonesia.org

REDD-I. (2012b). Frequently Asked Questions about REDD, from http://www.redd-indonesia.org

Ritung, S., Wahyunto, Agus, F., & Hidayat, H. (2007). Evaluasi Kesesuaian Lahan. Bogor, Indonesia: Balai Penelitian Tanah dan World Agroforestry Centre.

Sabandar, W. P. (2004). *Transport Development and The Rural Economy: Insights from Indonesia.* Doctor of Philosophy in Geography, University of Canterbury, Christchurch, New Zealand.

Schoen, J. (2004). Deforestation of Tropical Rainforests Near Palembang, Indonesia. *UW - L Journal of Undergraduate Research, VII*, 1-5.

Sheil, D., Casson, A., Meijaard, E., Noordwijk, M. v., Gaskell, J., Sunderland-Groves, J., . . . Kanninen, M. (2009). The Impacts and Opportunities of Oil Palm in Southeast Asia. What Do Know and What Do We Need to Know? Bogor, Indonesia: Centre for International Forestry Research (CIFOR).

Siregar, U., Rachmi, A., Massijaya, M. Y., Ishibashi, N., & Ando, K. (2007). Economic Analysis of Sengon (Paraserianthes falcataria) Community Forest Plantation, A Fast Growing Species in East Java, Indonesia. *Forest Policy and Economics, 9*(7), 822 - 829.

SPSS Inc. (2008). SPSS Statistics for Windows, Version 17.0. . Chicago: SPSS Inc. .

Sugardiman, R. A. (2007). *Spaceborne Radar Monitoring of Forest Fires and Forest Cover Change. A Case Study in Kalimantan* pHD, Wageningen University, Wageningen, The Netherlands.

Sunderlin, W. D. (1999). The Effects of Economic Crisis and Political Change on Indonesia's Forest Sector, 1997 - 1999. Bogor, Indonesia: Centre of International Forestry Research (CIFOR).

Sunderlin, W. D., Angelsen, A., Resosudarmo, D. P., & Dermawan, A. (2001). Economic Crisis, Small Farmer Well-Being, and Forest Cover Change in Indonesia. *World Development, 29*(5), 767 - 782.

Sunderlin, W. D., & Resosudarmo, D. P. (1996). Rates and Causes of Deforestation in Indonesia: Towards a Resolution of the Ambiguities. Bogor, Indonesia: Centre for International Forestry Research (CIFOR).

Sunderlin, W. D., & Resosudarmo, D. P. (1999). The Effect of Population and Migration on Forest Cover in Indonesia. *The Journal of Environment and Development, 8*(2), 152 - 169.

Syamsiatun, U. (2011). Kertas Kritik Masyarakat Sipil Sumatera untuk Hutan Tanaman Rakyat (HTR). Jambi, Indonesia.

Telapak. (1999). The Final Cut: Illegal Logging in Indonesia's Orangutan Parks, from telapak.gekkovoices.com/publikasi/download/The_Final_Cut.pdf

Tucker, C., Steininger, M., & Slayback, D. (2001). Measuring the State of the World's Forests. An Introduction to the Scientific Analysis of Forest Cover and Forest Loss. New York: Environmental Defense.

UNDP. (2004). Indonesia Human Development Report 2004. Jakarta, Indonesia: BPS, BAPPENAS and UNDP.

USGS. (2003). SLC Off-products: Background, from http://landsat.usgs.gov/products_slcoffbackground.php

Verchot, L. V., Petkova, E., Obidzinski, K., Atmadja, S., Yuliani, E. L., Dermawan, A., . . . Amira, S. (2010). Reducing forestry emissions in Indonesia. Bogor, Indonesia: Centre for International Forestry Research (CIFOR).

Whitten, A. J. (1987). Indonesia's Transmigration Program and its Role in the Loss of Tropical Rain Forests. *Conservation Biology, 1*(3), 239 - 246.

Whitten, A. J., Mustafa, M., & Henderson, G. S. (1988). *The Ecology of Sulawesi*. Jogyakarta: Gadjah Mada University Press.

Widisudarmo, R. (2001). Baseline study and gap analysis on mining in Indonesia. Mining, Minerals and Sustainable Development (MMSD) *Mining, Minerals and Sustainable Development (MMSD)* London.

Wijst, T. V. D. (1985). Transmigration in Indonesia: An Evaluation of a Population Redistribution Policy. *Population Research and Policy Review, 4*, 1 - 30.

Yulisman, L. (2013). RI Sees Bright Outlook for Palm Oil Exports, *The Jakarta Post*.

APPENDICES

Appendix A – Parameters for ‘deforestation”

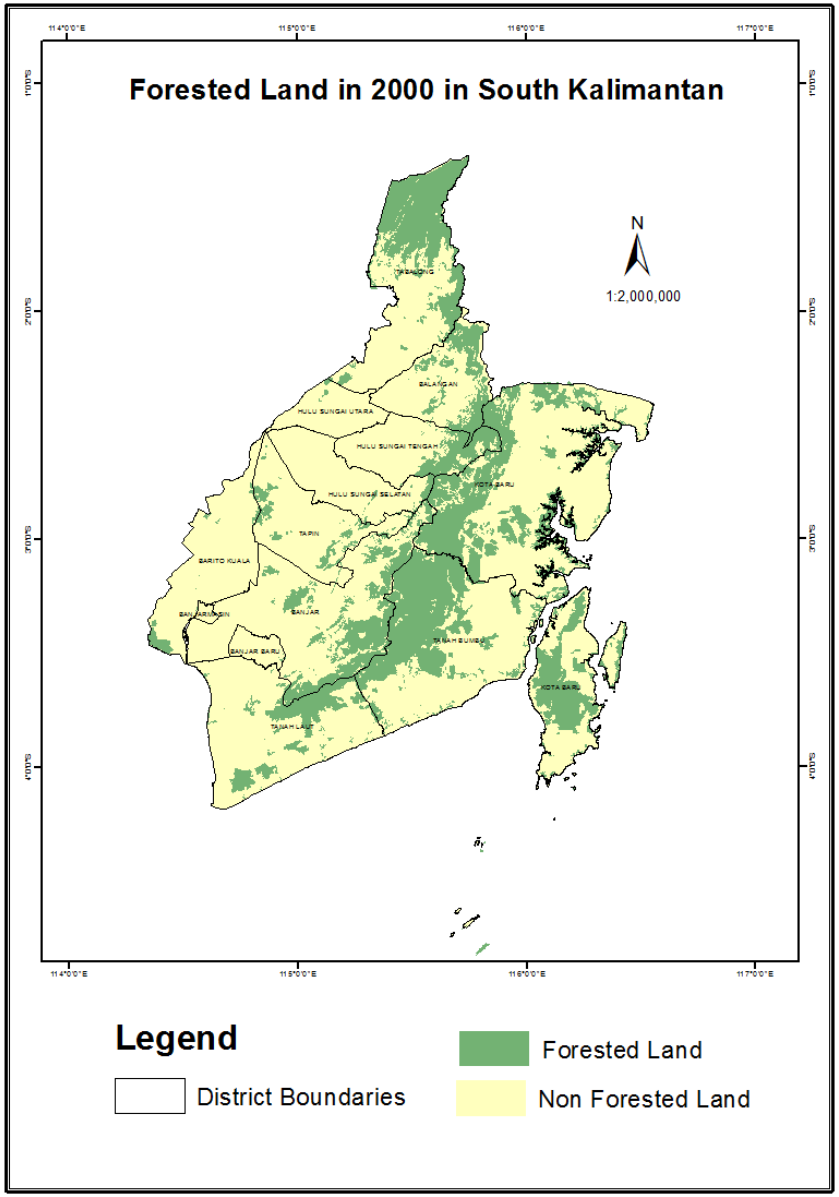
Parameter	Marrakech Accord (MA)	FAO / FRA
Transition from forest to non-forest		
Land-use change		
Crown cover change	< 10 – 30 %	< 10 %
Only directly human-induced		
Temporarily non-stocked condition does not constitute deforestation		

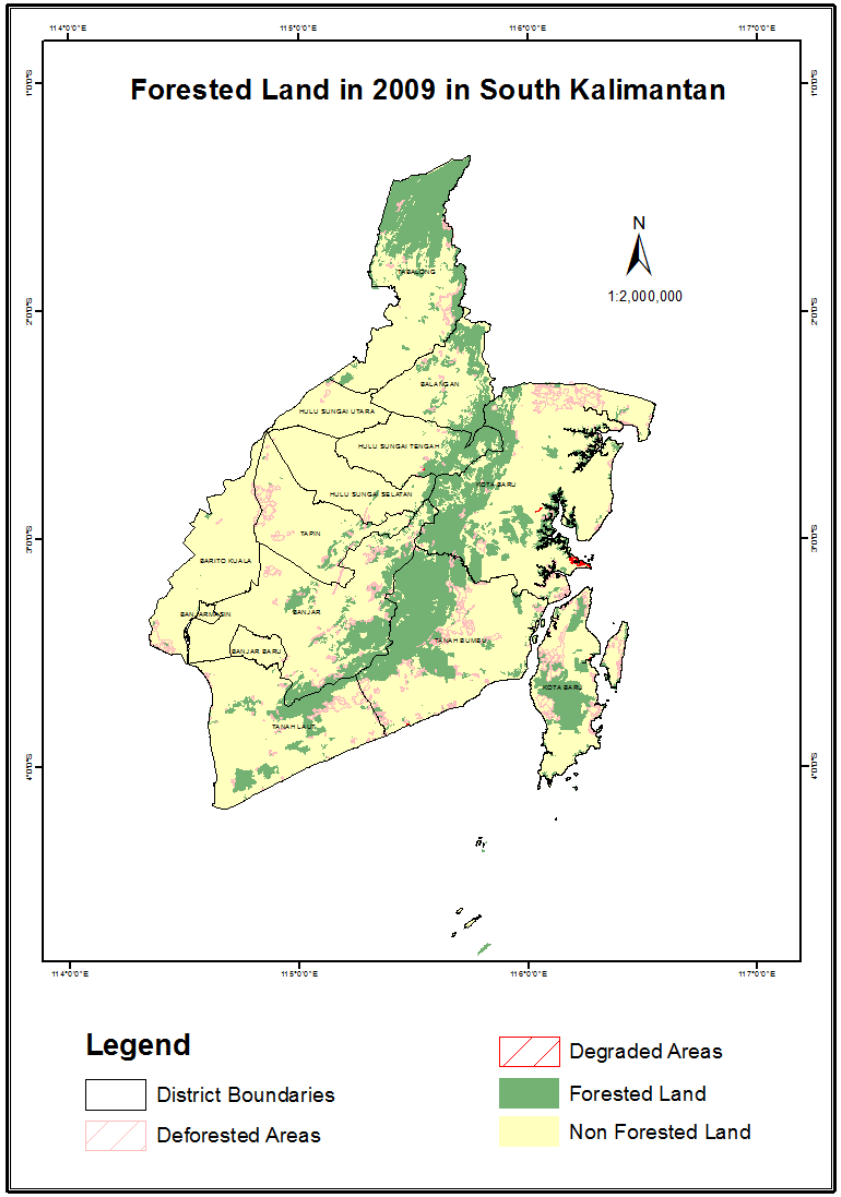
Source: FAO, 2003a

Appendix B – Parameters of forest degradation (Source: FAO, 2003b)

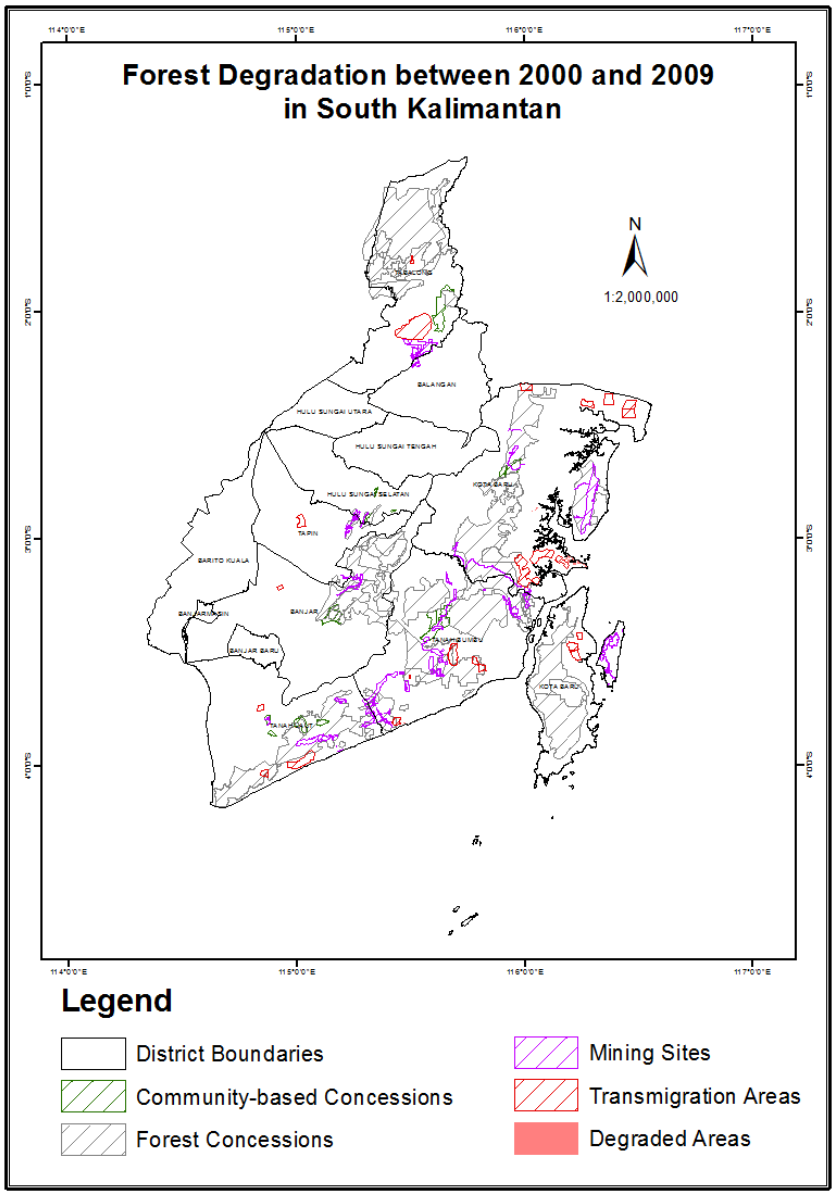
Parameter	FAO 2000	FAO 2000, 2006	FAO 2003	UNEP/CBD 2001	ITTO 2002	ITTO 2005	IPCC 2003d	IPCC 2003a	IPCC 2003b	IPCC 2003c
Forest Type										
Secondary forest										
Change within the forest										
Structure										
Crown cover	10%									
Species composition										
Stocking										
Reduction of capacity to provide:										
Productivity										
Goods										
Services										
Carbon stocks										
Other functions										
Time scale	long		long		long		long	long	long	long
Specific duration										
Cause										
Human-induced										
Natural										
Reference state										
Natural Forest										
Site										
Carbon stock at initial date										
Exclusion										
Deforestation										
Forest Management										

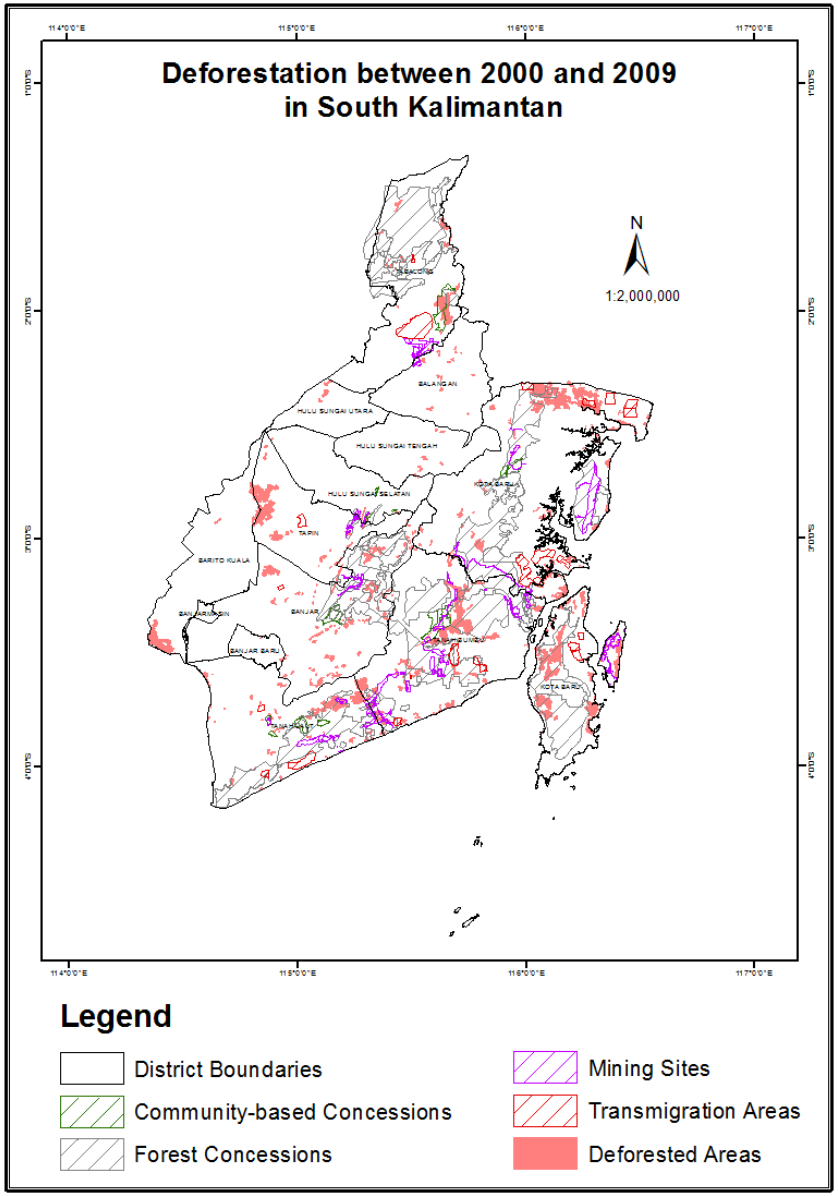
Appendix C –Maps of Forest Cover between 2000 and 2009 in South Kalimantan



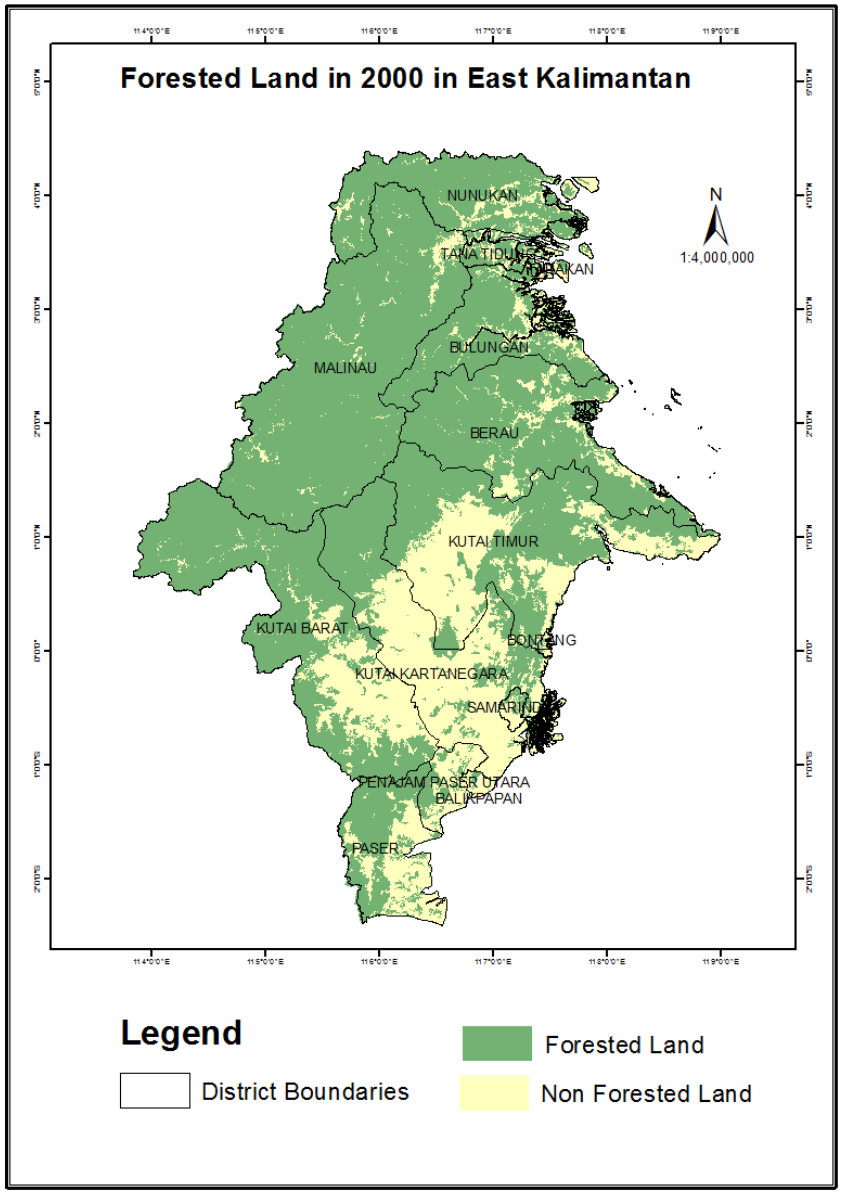


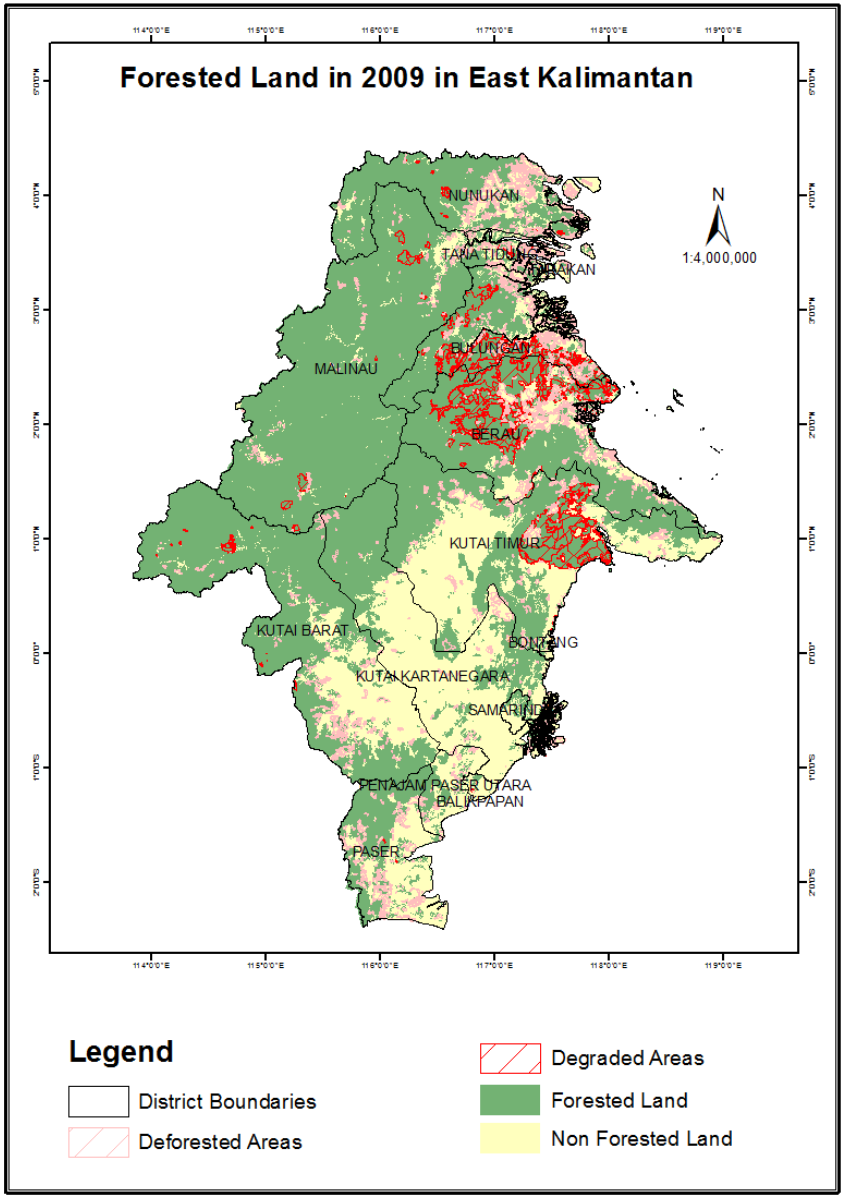
Appendix D –Maps of Forest Degradation and Deforestation in South Kalimantan



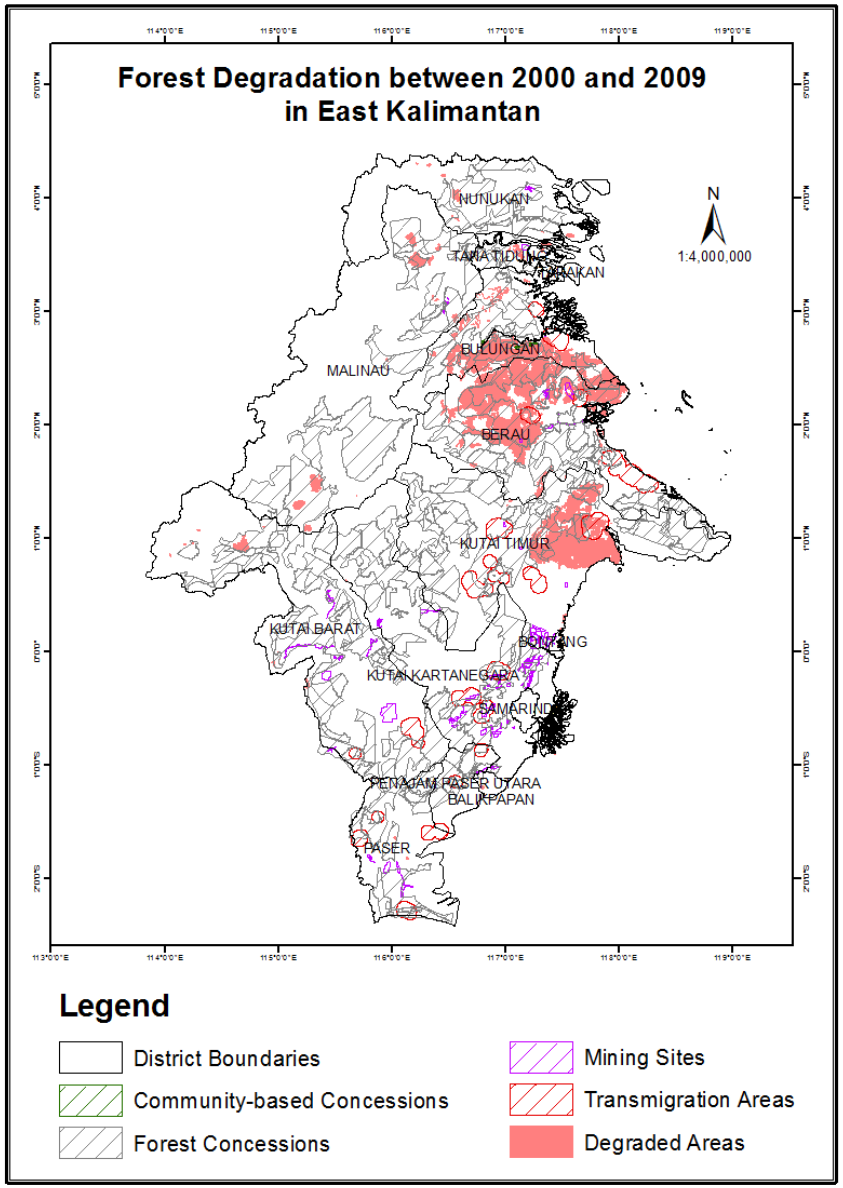


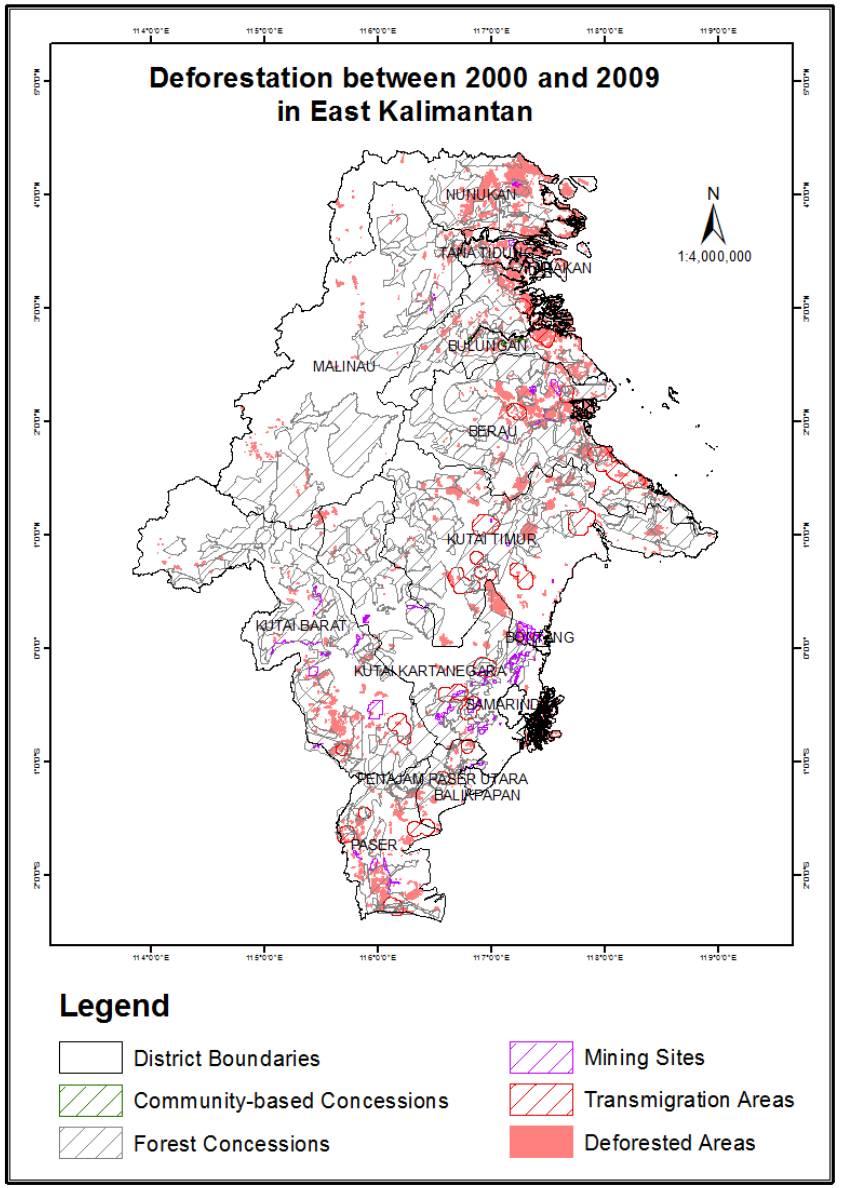
Appendix E – Maps of Forest Cover between 2000 and 2009 in East Kalimantan



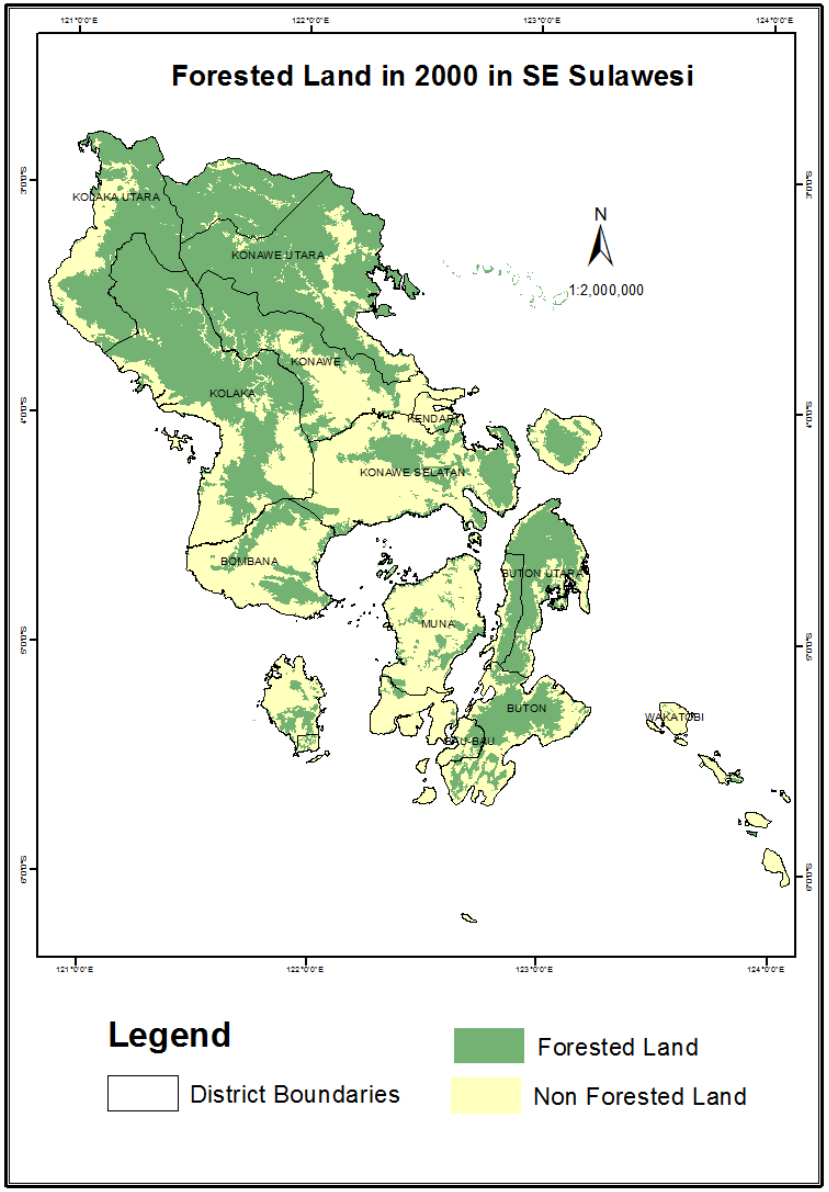


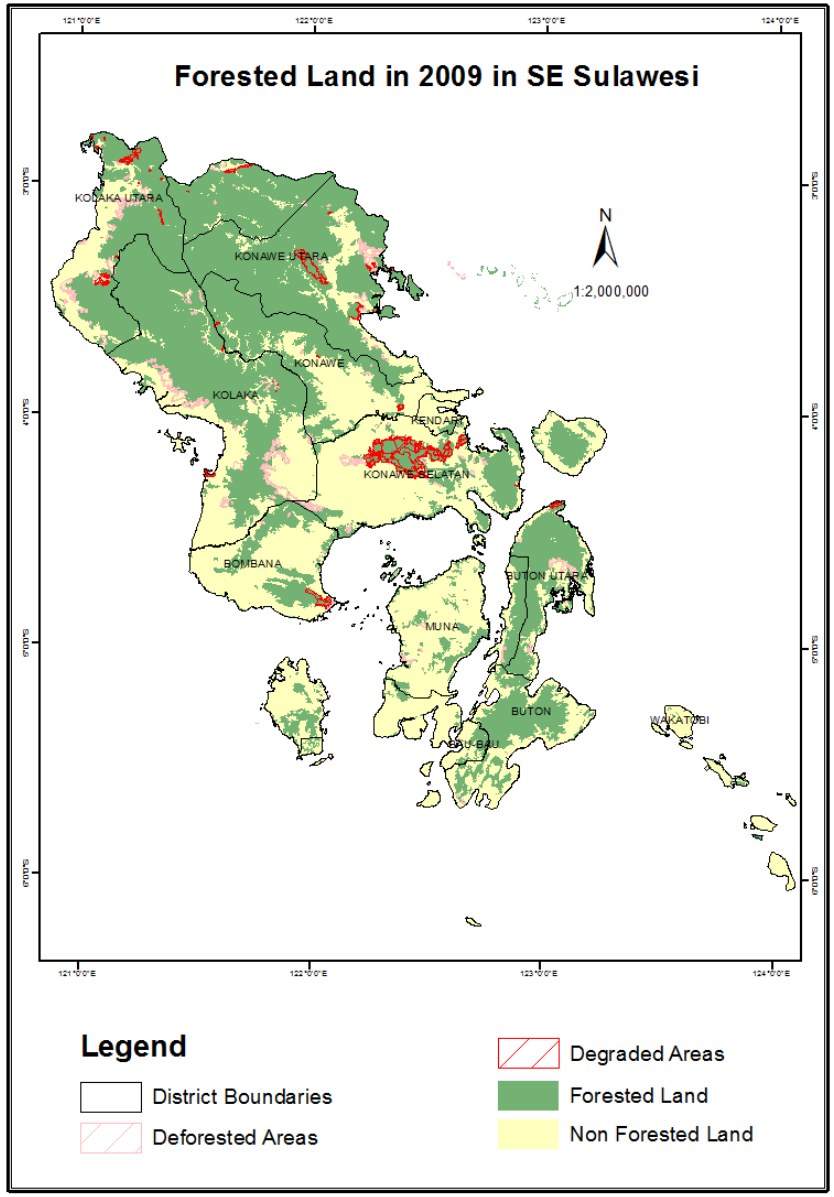
Appendix F – Maps of Forest Degradation and Deforestation in East Kalimantan



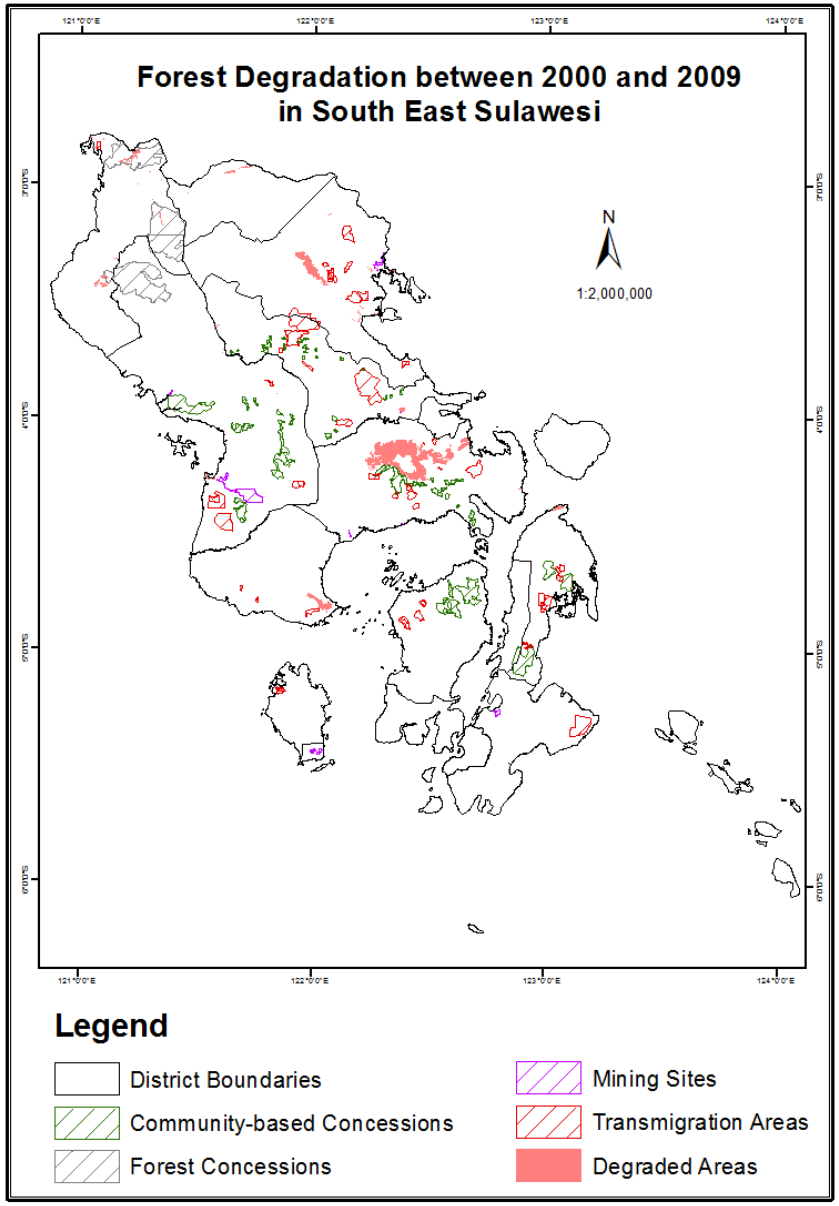


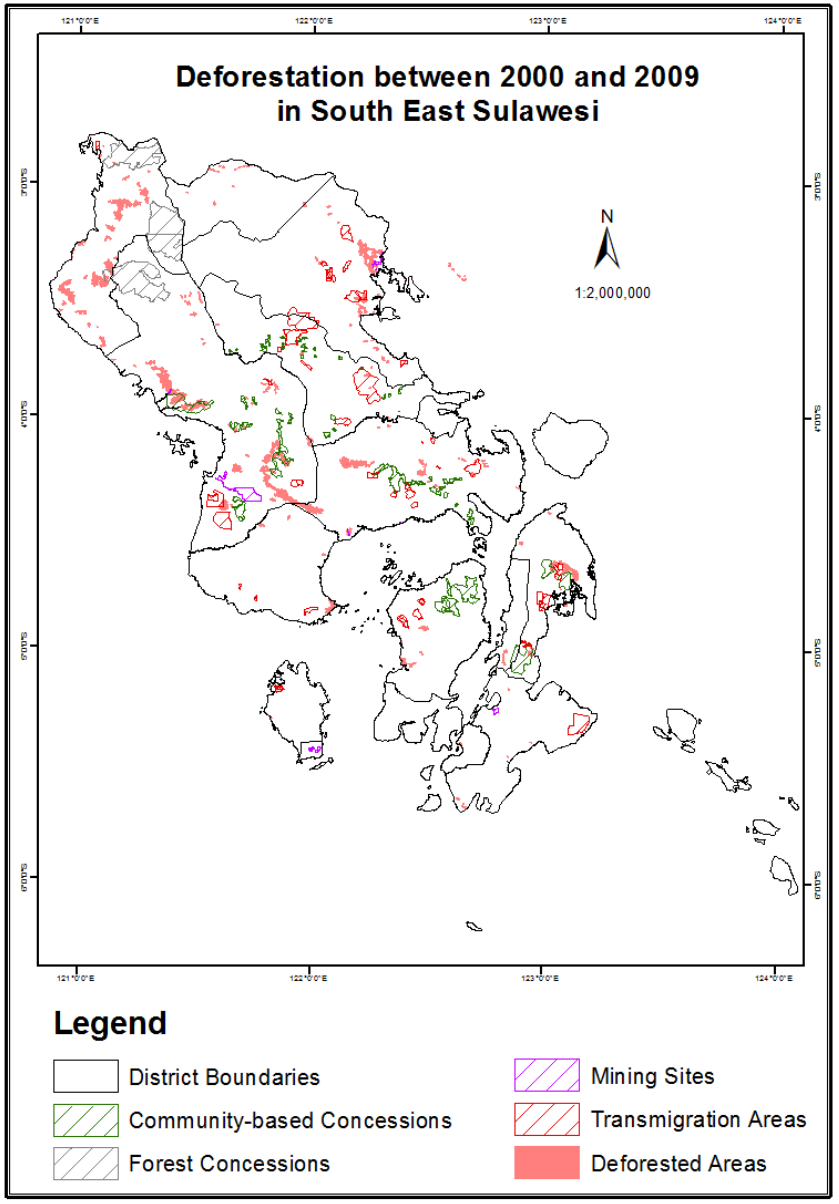
Appendix G – Maps of Forest Cover between 2000 and 2009 in SE Sulawesi



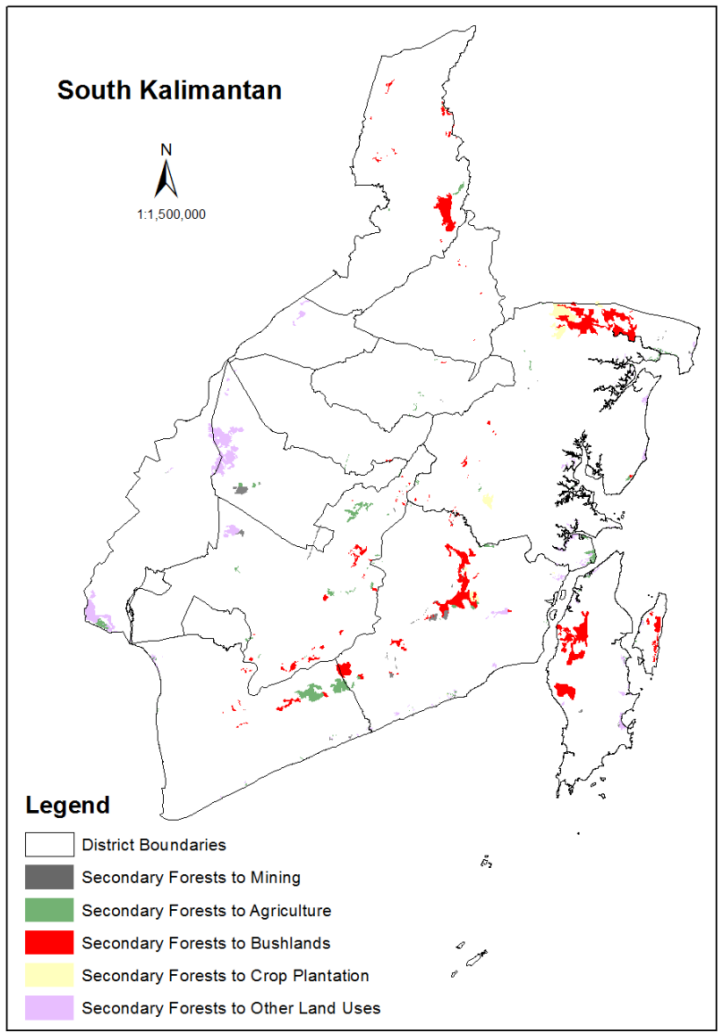


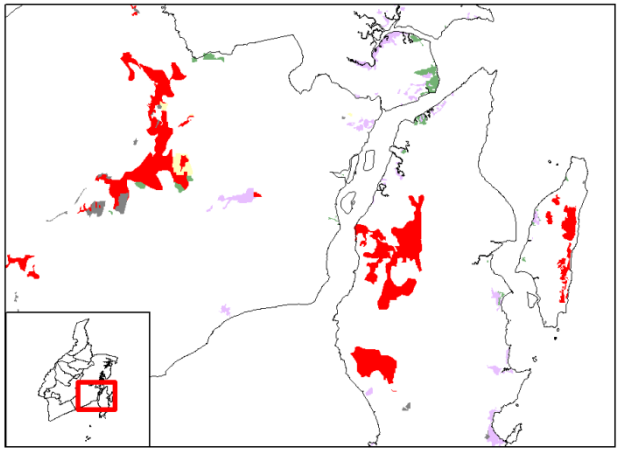
Appendix H – Maps of Forest Degradation and Deforestation in SE Sulawesi

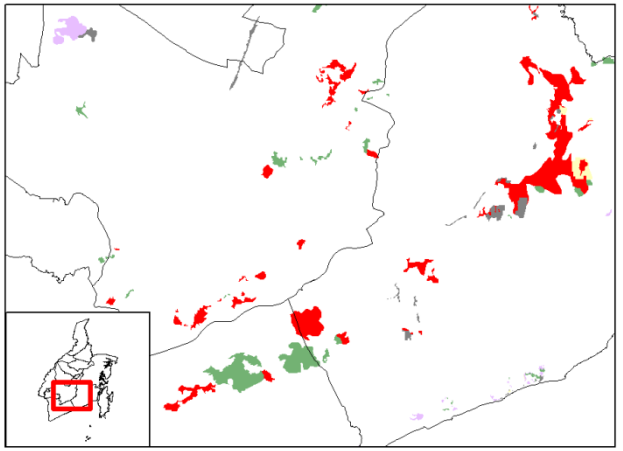


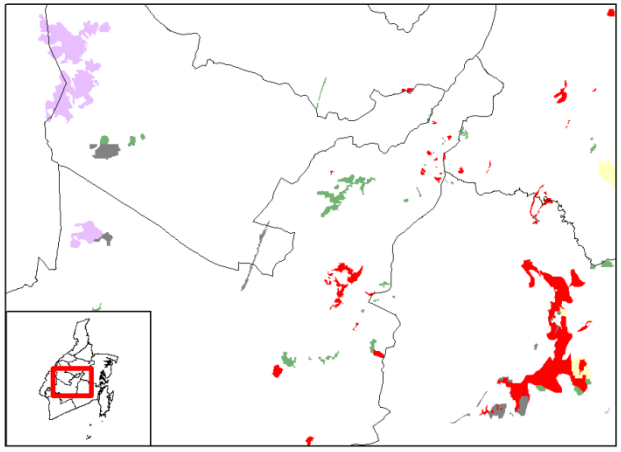


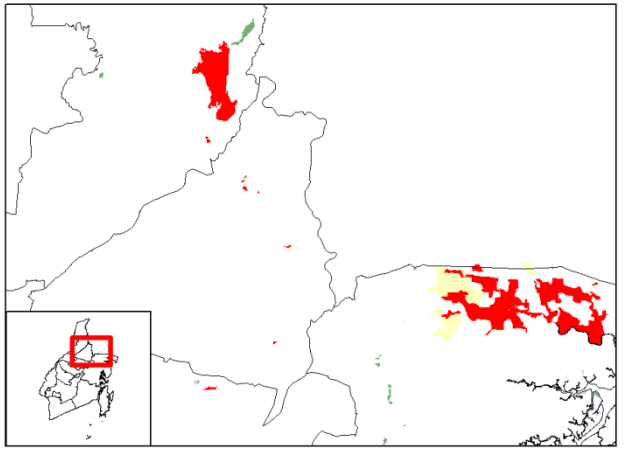
Appendix I – Maps of Secondary Forest Conversion to Other Land Uses in South Kalimantan



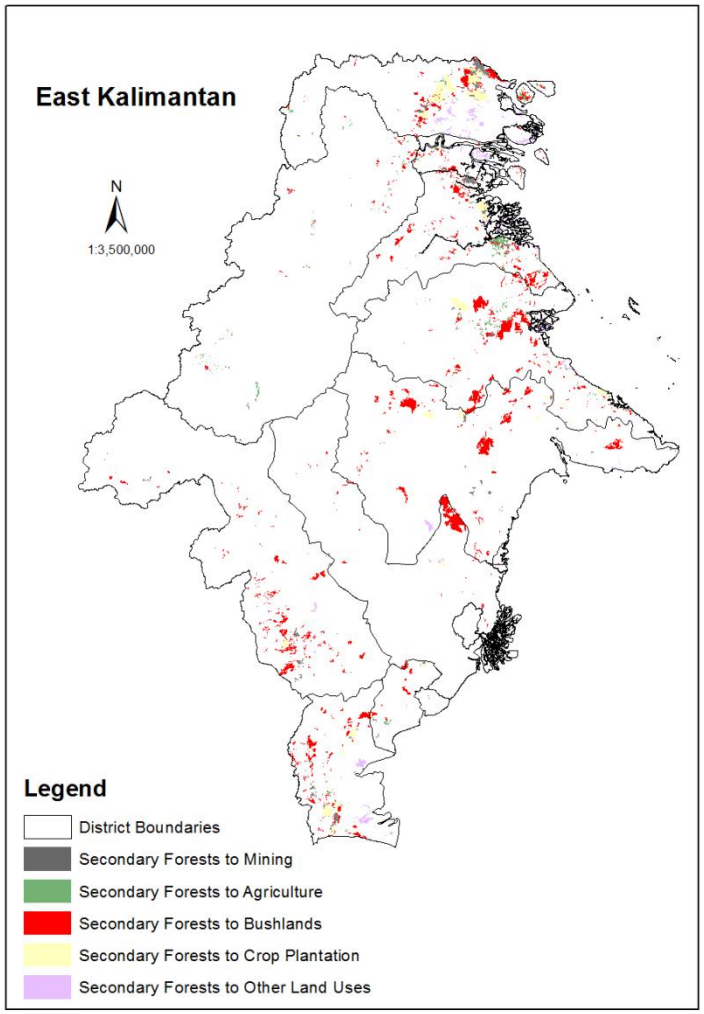


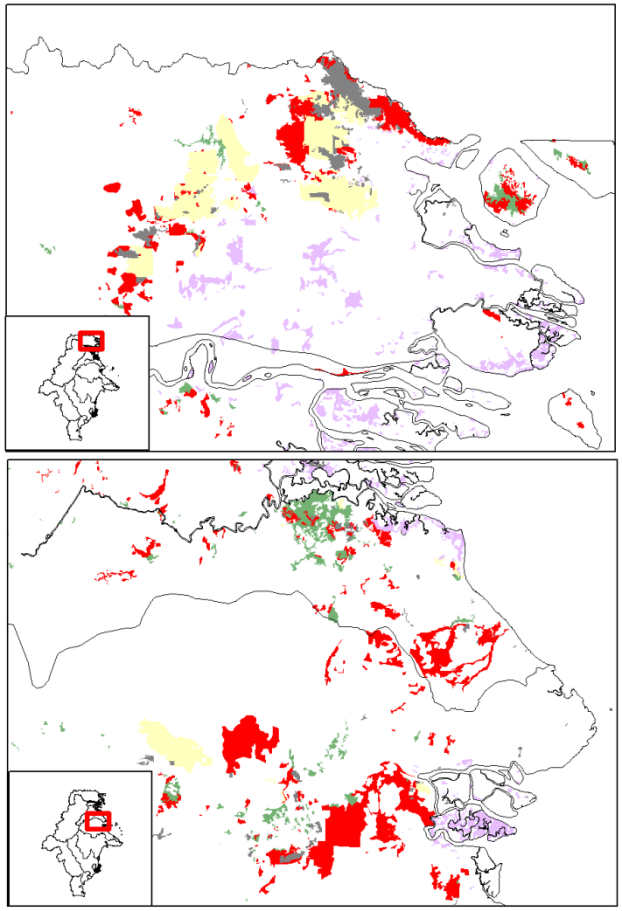


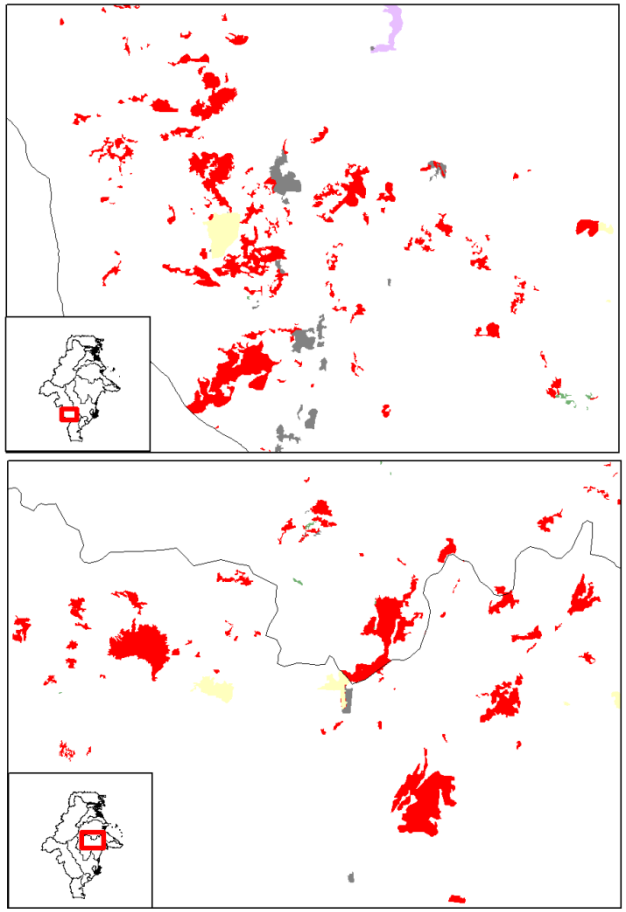




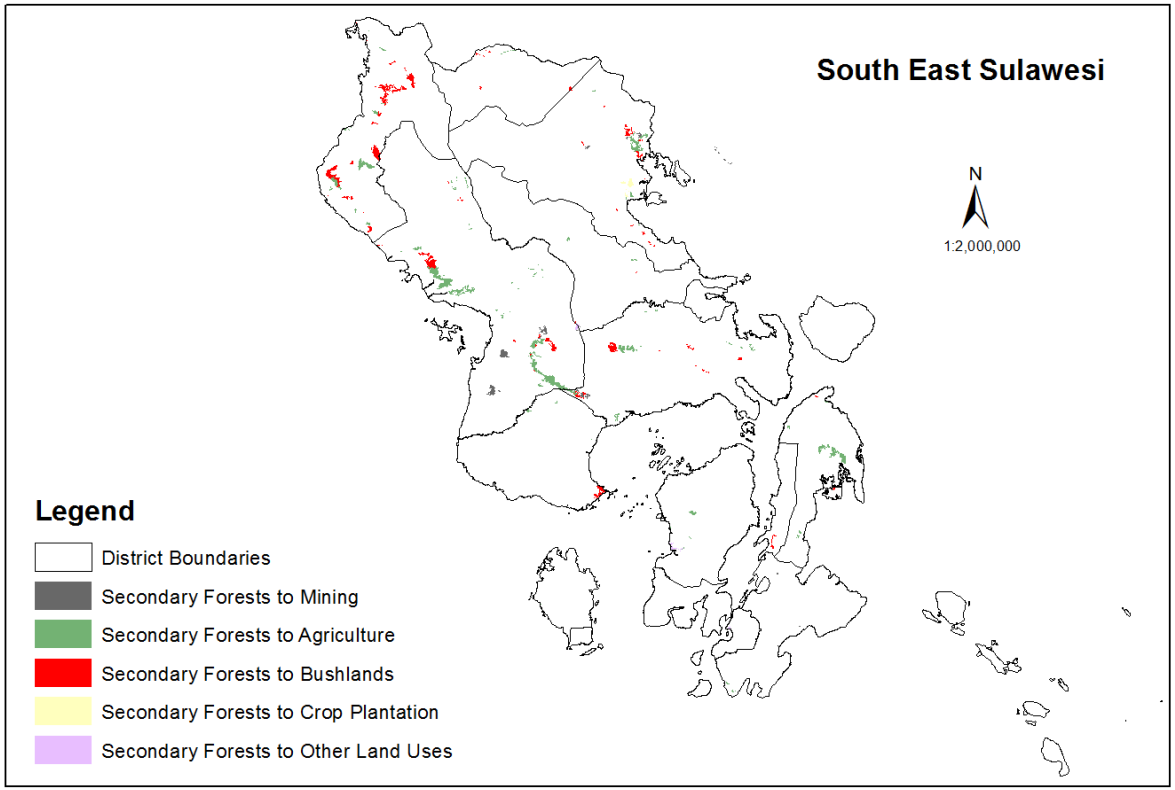
Appendix J – Maps of Secondary Forest Conversion to Other Land Uses in East Kalimantan

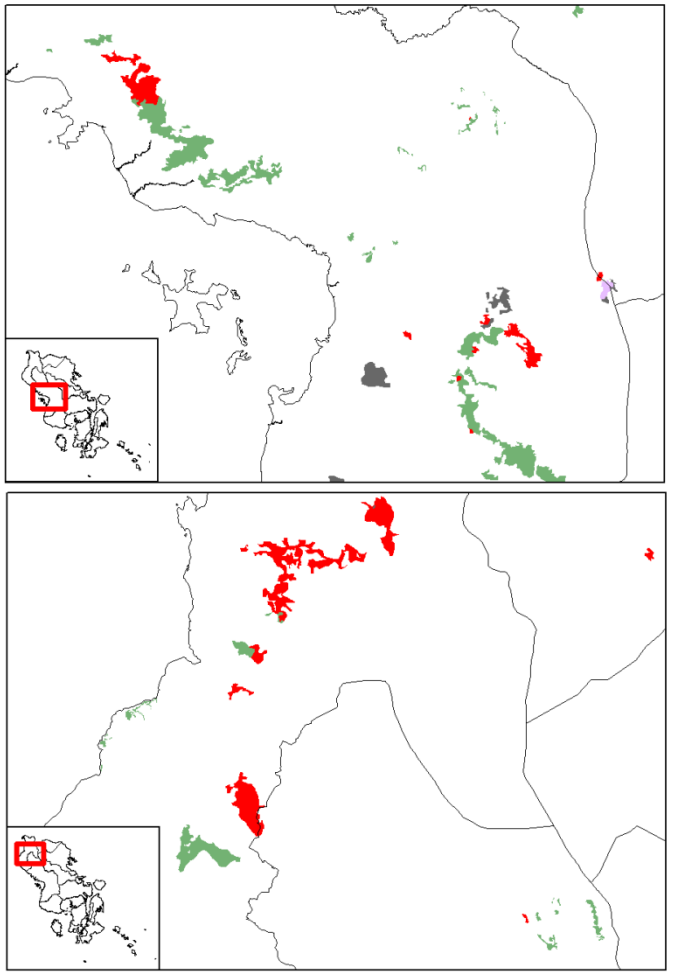






Appendix K – Maps of Secondary Forest Conversion to Other Land Uses in SE Sulawesi





Appendix L – The Rate of Forest Degradation and Deforestation between 2000 and 2009

No	Province	District	Primary Forests (Ha)	Secondary Forests (Ha)	Degraded Areas (Ha)	Degraded Areas (%)	Deforested Areas (Ha)	Deforested Areas (%)
1	South Kalimantan	BARITO KUALA	84	10382	0	0	8270	80
2		BANJARMASIN	0	0	0	0	0	0
3		BANJAR BARU	0	197	0	0	114	58
4		BANJAR	5191	95891	0	0	10474	11
5		HULU SUNGAI TENGAH	11375	32044	0	0	440	1
6		HULU SUNGAI SELATAN	3654	1558	0	0	304	20
7		HULU SUNGAI UTARA	0	1538	0	0	981	64
8		KOTA BARU	24308	293000	1269	5	50057	17
9		TANAH LAUT	4801	38168	0	0	10260	27
10		TAPIN	0	14351	0	0	12123	84
11		TABALONG	760	153746	0	0	8902	6
12		TANAH BUMBU	268	189374	0	0	23590	12
13		BALANGAN	12657	32841	0	0	153	0
South Kalimantan in total			**63098**	**863089**	**1269**	**5**	**125668**	**15**
14	East Kalimantan	KUTAI TIMUR	767748	1042413	348938	45	95497	9
15		BERAU	1161477	737971	556338	48	132741	18
16		KUTAI BARAT	911800	1465776	13366	1	67436	5
17		PASER	10893	608102	592	5	86726	14
18		BALIKPAPAN	2989	7231	246	8	195	3
19		TARAKAN	0	9348	0	0	2624	28
20		KUTAI KARTANEGARA	288383	681161	135	0	58222	9
21		SAMARINDA	0	24475	0	0	22	0
22		BULUNGAN	542651	521207	226381	42	114275	22
23		MALINAU	3202659	653779	48558	2	20877	3
24		NUNUKAN	546309	676452	6283	1	157746	23
25		BONTANG	14	6407	2	14	217	3
26		PENAJAM PASER UTARA	1588	105606	0	0	13166	12
27		TANA TIDUNG	17482	174862	7328	42	42822	24
East Kalimantan in total			**7453993**	**6714791**	**1208167**	**16**	**792566**	**12**
28	SE Sulawesi	KOLAKA	250944	206985	825	0	21641	10
29		KONAWE	162169	220530	1543	1	1432	1
30		MUNA	831	76539	0	0	1656	2
31		BUTON	17226	103966	0	0	286	0
32		KENDARI	41	3052	0	0	0	0
33		BAU-BAU	809	9533	0	0	90	1
34		KONAWE SELATAN	66801	82766	36187	54	6568	8
35		KOLAKA UTARA	128075	111175	2924	2	13789	12
36		WAKATOBI	860	2343	0	0	0	0
37		BOMBANA	27795	74202	3605	13	1765	2
38		KONAWE UTARA	188367	202702	7593	4	7035	3
39		BUTON UTARA	6955	120334	679	10	3811	3
SE Sulawesi in total			**850873**	**1214127**	**53356**	**6**	**58073**	**5**

Appendix M– Forest Concessions and the Proportion of Degraded Areas in Primary Forest that Occurs in Forest Concessions

No	Province	District	Forest Concessions						Degradation	Degradation	The proportion of degraded areas in primary forest that occurs in forest concessions					
			Natural (unit)	Natural (Ha)	Plantation (Unit)	Plantation (Ha)	Total (Unit)	Total (Ha)	(Ha)	(%)	Natural (Ha)	Natural (%)	Plantation (Ha)	Plantation (%)	Total (Ha)	Total (%)
1	South Kalimantan	BARITO KUALA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2		BANJARMASIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3		BANJAR BARU	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4		BANJAR	0	0	5	83204	5	83204	0	0	0	0	0	0	0	0
5		HULU SUNGAI TENGAH	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6		HULU SUNGAI SELATAN	0	0	1	3356	1	3356	0	0	0	0	0	0	0	0
7		HULU SUNGAI UTARA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8		KOTA BARU	2	123251	4	125246	6	248497	1269	5	0	0	0	0	0	0
9		TANAH LAUT	0	0	2	94939	2	94939	0	0	0	0	0	0	0	0
10		TAPIN	0	0	2	4214	2	4214	0	0	0	0	0	0	0	0
11		TABALONG	2	99168	4	43290	6	142457	0	0	0	0	0	0	0	0
12		TANAH BUMBU	1	18240	4	166757	5	184996	0	0	0	0	0	0	0	0
13		BALANGAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Kalimantan in total			**5**	**240658**	**22**	**521006**	**27**	**761664**	**1269**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
14	East Kalimantan	KUTAI TIMUR	19	963983	16	391385	35	1355367	348938	45	47810	14	71357	20	119167	34
15		BERAU	23	942852	6	280152	29	1223004	556338	48	347799	63	27107	5	374905	67
16		KUTAI BARAT	25	1119339	9	139040	34	1258380	13366	1	11400	85	0	0	11400	85
17		PASER	10	410523	3	74526	13	485048	592	5	382	65	0	0	382	65
18		BALIKPAPAN	0	0	1	3590	1	3590	246	8	0	0	0	0	0	0
19		TARAKAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20		KUTAI KARTANEGARA	11	551519	13	441038	24	992557	135	0	0	0	0	0	0	0
21		SAMARINDA	0	0	1	744	1	744	0	0	0	0	0	0	0	0
22		BULUNGAN	11	530229	5	43631	16	573860	226381	42	143874	64	11011	5	154885	68
23		MALINAU	19	1265999	2	46553	21	1312552	48558	2	42988	89	0	0	42988	89
24		NUNUKAN	5	271996	2	92376	7	364372	6283	1	3952	0	0	0	3952	0
25		BONTANG	0	0	0	0	0	0	2	14	0	0	0	0	0	0
26		PENAJAM PASER UTARA	3	74182	4	97053	7	171235	0	0	0	0	0	0	0	0
27		TANA TIDUNG	2	29887	2	92629	4	122516	7328	42	0	0	4225	58	4225	58
East kalimantan in total			**128**	**6160509**	**64**	**1702718**	**192**	**7863226**	**1208167**	**16**	**598206**	**50**	**113699**	**9**	**711905**	**59**
28	SE Sulawesi	KOLAKA	1	31555	0	0	1	31555	825	0	0	0	0	0	0	0
29		KONAWE	0	0	0	0	0	0	1543	1	0	0	0	0	0	0
30		MUNA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31		BUTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32		KENDARI	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33		BAU-BAU	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34		KONAWE SELATAN	0	0	0	0	0	0	36187	54	0	0	0	0	0	0
35		KOLAKA UTARA	2	58108	0	0	2	58108	2924	2	2304	54	0	0	2304	54
36		WAKATOBI	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37		BOMBANA	0	0	0	0	0	0	3605	13	0	0	0	0	0	0
38		KONAWE UTARA	0	0	0	0	0	0	7593	4	0	0	0	0	0	0
39		BUTON UTARA	0	0	0	0	0	0	679	10	0	0	0	0	0	0
SE Sulawesi in total			**3**	**89663**	**0**	**0**	**3**	**89663**	**53356**	**6**	**2304**	**4**	**0**	**0**	**2304**	**4**

Appendix N – The Proportion of Degraded Areas in Primary Forest that Occurs in the Selected Direct and Underlying Causes

No	Province	District	Degradation (Ha)	Degradation (%)	The proportion of degraded areas in primary forest that occurs in the selected direct and underlying causes							
					Slope (Ha)	Slope (%)	Road (Ha)	Road (%)	Comm-based (Ha)	Comm-based (%)	Transmigration (Ha)	Transmigration (%)
1	South Kalimantan	BARITO KUALA	0	0	0	0	0	0	0	0	0	0
2		BANJARMASIN	0	0	0	0	0	0	0	0	0	0
3		BANJAR BARU	0	0	0	0	0	0	0	0	0	0
4		BANJAR	0	0	0	0	0	0	0	0	0	0
5		HULU SUNGAI TENGAH	0	0	0	0	0	0	0	0	0	0
6		HULU SUNGAI SELATAN	0	0	0	0	0	0	0	0	0	0
7		HULU SUNGAI UTARA	0	0	0	0	0	0	0	0	0	0
8		KOTA BARU	1269	5	1269	100	79	6	0	0	1204	95
9		TANAH LAUT	0	0	0	0	0	0	0	0	0	0
10		TAPIN	0	0	0	0	0	0	0	0	0	0
11		TABALONG	0	0	0	0	0	0	0	0	0	0
12		TANAH BUMBU	0	0	0	0	0	0	0	0	0	0
13		BALANGAN	0	0	0	0	0	0	0	0	0	0
South Kalimantan in total			**1269**	**2**	**1269**	**100**	**79**	**6**	**0**	**0**	**1204**	**95**
14	East Kalimantan	KUTAI TIMUR	348938	45	186557	53	149839	43	0	0	28696	8
15		BERAU	556338	48	291947	52	282704	51	0	0	13898	2
16		KUTAI BARAT	13366	1	5161	39	1521	11	0	0	0	0
17		PASER	592	5	208	35	6	1	0	0	0	0
18		BALIKPAPAN	246	8	116	47	85	35	0	0	0	0
19		TARAKAN	0	0	0	0	0	0	0	0	0	0
20		KUTAI KARTANEGARA	135	0	118	87	0	0	0	0	0	0
21		SAMARINDA	0	0	0	0	0	0	0	0	0	0
22		BULUNGAN	226381	42	110446	49	147858	65	18266	8	2545	1
23		MALINAU	48558	2	877	2	5491	11	0	0	0	0
24		NUNUKAN	6283	1	322	5	3040	48	0	0	0	0
25		BONTANG	2	14	2	100	0	0	0	0	0	0
26		PENAJAM PASER UTARA	0	0	0	0	0	0	0	0	0	0
27		TANA TIDUNG	7328	42	7296	100	2389	33	0	0	0	0
East Kalimantan in total			**1208167**	**16**	**603050**	**50**	**592933**	**49**	**18266**	**2**	**45139**	**4**
28	SE Sulawesi	KOLAKA	825	0	305	37	614	74	58	7	18	2
29		KONAWE	1543	1	151	10	554	36	53	3	0	0
30		MUNA	0	0	0	0	0	0	0	0	0	0
31		BUTON	0	0	0	0	0	0	0	0	0	0
32		KENDARI	0	0	0	0	0	0	0	0	0	0
33		BAU-BAU	0	0	0	0	0	0	0	0	0	0
34		KONAWE SELATAN	36187	54	5404	15	4599	13	10435	29	6982	19
35		KOLAKA UTARA	2924	2	162	6	406	14	0	0	314	11
36		WAKATOBI	0	0	0	0	0	0	0	0	0	0
37		BOMBANA	3605	13	43	1	40	1	0	0	2197	61
38		KONAWE UTARA	7593	4	247	3	652	9	0	0	2292	30
39		BUTON UTARA	679	10	0	0	17	3	0	0	0	0
SE Sulawesi in total			**53356**	**6**	**6312**	**12**	**6882**	**13**	**10546**	**20**	**11803**	**22**

Appendix O – Deforestation by its Component at District Level

No	Province	District	Deforestation (Ha)	Deforestation (%)	Secondary forest conversion to different land uses									
					to Bushland (Ha)	to Bushland (%)	to Agr (Ha)	to Agr (%)	to Mining (Ha)	to Mining (%)	to Crop Plant. (Ha)	to Crop Plant. (%)	to Others (Ha)	to Others (%)
1	South Kalimantan	BARITO KUALA	8270	80	0	0	986	10	23	0	0	0	7261	70
2		BANJARMASIN	0	0	0	0	0	0	0	0	0	0	0	0
3		BANJAR BARU	114	58	0	0	114	58	0	0	0	0	0	0
4		BANJAR	10474	11	4479	5	3532	4	682	1	0	0	1781	2
5		HULU SUNGAI TENGAH	440	1	107	0	293	1	40	0	0	0	0	0
6		HULU SUNGAI SELATAN	304	20	104	7	153	10	0	0	0	0	47	3
7		HULU SUNGAI UTARA	981	64	0	0	0	0	0	0	0	0	981	64
8		KOTA BARU	50057	17	32949	11	3194	1	473	0	7268	2	6173	2
9		TANAH LAUT	10260	27	2614	7	6750	18	171	0	0	0	725	2
10		TAPIN	12123	84	0	0	566	4	1629	11	0	0	9928	69
11		TABALONG	8902	6	8122	5	612	0	41	0	127	0	0	0
12		TANAH BUMBU	23590	12	16008	8	1800	1	2312	1	1220	1	2250	1
13		BALANGAN	153	0	153	0	0	0	0	0	0	0	0	0
South Kalimantan in total			**125668**	**15**	**64535**	**51**	**18000**	**14**	**5372**	**4**	**8615**	**7**	**29146**	**23**
14	East Kalimantan	KUTAI TIMUR	95497	9	60729	6	809	0	5266	1	8777	1	4323	0
15		BERAU	132741	18	61718	8	12995	2	7529	1	18227	2	11038	1
16		KUTAI BARAT	67436	5	52645	4	316	0	7737	1	3783	0	1596	0
17		PASER	86726	14	35748	6	2297	0	8493	1	19851	3	5562	1
18		BALIKPAPAN	195	3	132	2	28	0	7	0	0	0	0	0
19		TARAKAN	2624	28	1230	13	495	5	872	9	0	0	26	0
20		KUTAI KARTANEGARA	58222	9	37259	5	5203	1	325	0	1620	0	3122	0
21		SAMARINDA	22	0	12	0	0	0	10	0	0	0	0	0
22		BULUNGAN	114275	22	47295	9	30627	6	10930	2	10328	2	13317	3
23		MALINAU	20877	3	8270	1	8986	1	813	0	0	0	403	0
24		NUNUKAN	157746	23	38967	6	9270	1	18670	3	54507	8	19520	3
25		BONTANG	217	3	32	0	0	0	74	1	0	0	105	2
26		PENAJAM PASER UTARA	13166	12	6882	7	1621	2	984	1	2523	2	64	0
27		TANA TIDUNG	42822	24	6400	4	7205	4	2612	1	0	0	14458	8
East Kalimantan in total			**792566**	**12**	**357319**	**45**	**79852**	**10**	**64322**	**8**	**119616**	**15**	**73534**	**9**
28	SE Sulawesi	KOLAKA	21641	10	4268	2	13895	7	3218	2	0	0	260	0
29		KONAWE	1432	1	604	0	661	0	100	0	0	0	68	0
30		MUNA	1656	2	435	1	676	1	8	0	0	0	537	1
31		BUTON	286	0	17	0	205	0	64	0	0	0	0	0
32		KENDARI	0	0	0	0	0	0	0	0	0	0	0	0
33		BAU-BAU	90	1	0	0	0	0	0	0	0	0	90	1
34		KONAWE SELATAN	6568	8	2802	3	3075	4	690	1	0	0	0	0
35		KOLAKA UTARA	13789	12	10163	9	3619	3	8	0	0	0	0	0
36		WAKATOBI	0	0	0	0	0	0	0	0	0	0	0	0
37		BOMBANA	1765	2	1342	2	423	1	0	0	0	0	0	0
38		KONAWE UTARA	7035	3	2366	1	2800	1	654	0	1214	1	0	0
39		BUTON UTARA	3811	3	135	0	7223	6	0	0	0	0	14	0
SE Sulawesi in total			**58073**	**5**	**22132**	**38**	**32577**	**56**	**4742**	**8**	**1214**	**2**	**969**	**2**

Appendix P – Forest Concessions and the Proportion of Deforested Areas in Secondary Forest that Occurs in Forest Concessions

No	Province	District	Forest Concessions						Deforestation (Ha)	Deforestation (%)	The proportion of deforested areas in secondary forest that occurs in forest concessions					
			Natural (unit)	Natural (Ha)	Plantation (Unit)	Plantation (Ha)	Total (Unit)	Total (Ha)			Natural (Ha)	Natural (%)	Plantation (Ha)	Plantation (%)	Total (Ha)	Total (%)
1	South Kalimantan	BARITO KUALA	0	0	0	0	0	0	8270	80	0	0	0	0	0	0
2		BANJARMASIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3		BANJAR BARU	0	0	0	0	0	0	114	58	0	0	0	0	0	0
4		BANJAR	0	0	5	83204	5	83204	10474	11	0	0	2931	28	2931	28
5		HULU SUNGAI TENGAH	0	0	0	0	0	0	440	1	0	0	0	0	0	0
6		HULU SUNGAI SELATAN	0	0	1	3356	1	3356	304	20	0	0	0	0	0	0
7		HULU SUNGAI UTARA	0	0	0	0	0	0	981	64	0	0	0	0	0	0
8		KOTA BARU	2	123251	4	125246	6	248497	50057	17	10708	21	7421	15	18129	36
9		TANAH LAUT	0	0	2	94939	2	94939	10260	27	0	0	3972	45	3972	45
10		TAPIN	0	0	2	4214	2	4214	12123	84	0	0	75	1	75	1
11		TABALONG	2	99168	4	43290	6	142457	8902	6	2446	27	378	4	2824	32
12		TANAH BUMBU	1	18240	4	166757	5	184996	23590	12	1122	5	7855	33	8977	38
13		BALANGAN	0	0	0	0	0	0	153	0	0	0	0	0	0	0
South Kalimantan in total			**5**	**240658**	**22**	**521006**	**27**	**761664**	**125668**	**15**	**14276**	**11**	**22632**	**18**	**36908**	**30**
14	East Kalimantan	KUTAI TIMUR	19	963983	16	391385	35	1355367	95497	9	38095	40	6290	7	44385	46
15		BERAU	23	942852	6	280152	29	1223004	132741	18	16108	12	39289	30	55397	42
16		KUTAI BARAT	25	1119339	9	139040	34	1258380	67436	5	22646	34	13620	20	36266	54
17		PASER	10	410523	3	74526	13	485048	86726	14	45939	53	9635	11	55574	64
18		BALIKPAPAN	0	0	1	3590	1	3590	195	3	0	0	0	0	0	0
19		TARAKAN	0	0	0	0	0	0	2624	28	0	0	0	0	0	0
20		KUTAI KARTANEGARA	11	551519	13	441038	24	992557	58222	9	2613	4	6532	11	9145	16
21		SAMARINDA	0	0	1	744	1	744	22	0	0	0	0	0	0	0
22		BULUNGAN	11	530229	5	43631	16	573860	114275	22	23469	21	5547	5	29016	25
23		MALINAU	19	1265999	2	46553	21	1312552	20877	3	4911	24	3944	19	8855	42
24		NUNUKAN	5	271996	2	92376	7	364372	157746	23	11489	7	22673	14	34162	22
25		BONTANG	0	0	0	0	0	0	217	3	0	0	0	0	0	0
26		PENAJAM PASER UTARA	3	74182	4	97053	7	171235	13166	12	697	5	9327	71	10024	76
27		TANA TIDUNG	2	29887	2	92629	4	122516	42822	24	801	2	11865	28	12666	30
East Kalimantan in total			**128**	**6160509**	**64**	**1702718**	**192**	**7863226**	**792566**	**12**	**166768**	**21**	**128722**	**16**	**295490**	**37**
28	SE Sulawesi	KOLAKA	1	31555	0	0	1	31555	21641	10	100	0	0	0	100	0
29		KONAWE	0	0	0	0	0	0	1432	1	0	0	0	0	0	0
30		MUNA	0	0	0	0	0	0	1656	2	0	0	0	0	0	0
31		BUTON	0	0	0	0	0	0	286	0	0	0	0	0	0	0
32		KENDARI	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33		BAU-BAU	0	0	0	0	0	0	90	1	0	0	0	0	0	0
34		KONAWE SELATAN	0	0	0	0	0	0	6568	8	0	0	0	0	0	0
35		KOLAKA UTARA	2	58108	0	0	2	58108	13789	12	382	1	0	0	382	1
36		WAKATOBI	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37		BOMBANA	0	0	0	0	0	0	1765	2	0	0	0	0	0	0
38		KONAWE UTARA	0	0	0	0	0	0	7035	3	0	0	0	0	0	0
39		BUTON UTARA	0	0	0	0	0	0	3811	3	0	0	0	0	0	0
SE Sulawesi in total			**3**	**89663**	**0**	**0**	**3**	**89663**	**58073**	**5**	**482**	**0**	**0**	**0**	**482**	**0**

Appendix Q – The Proportion of Deforested Areas in Secondary Forest that Occurs in Mining, Road, Slope, Transmigration and Community-based Concessions

No	Province	District	Deforestation (Ha)	Deforestation (%)	The proportion of deforested areas in secondary forestthat occurs in the selected direct and underlying causes									
					Mining Sites (Ha)	Mining Sites (%)	Road (Ha)	Road (%)	Slope (Ha)	Slope (%)	Transmigration (Ha)	Trans. (%)	Comm-based (Ha)	Comm-based (%)
1	South Kalimantan	BARITO KUALA	8270	80	0	0	186	2	8270	100	0	0	0	0
2		BANJARMASIN	0	0	0	0	0	0	0	0	0	0	0	0
3		BANJAR BARU	114	58	0	0	0	0	114	100	0	0	0	0
4		BANJAR	10474	11	0	0	2690	26	10085	96	12	0	665	6
5		HULU SUNGAI TENGAH	440	1	0	0	0	0	355	81	0	0	0	0
6		HULU SUNGAI SELATAN	304	20	0	0	0	0	281	92	0	0	225	74
7		HULU SUNGAI UTARA	981	64	0	0	0	0	981	100	0	0	0	0
8		KOTA BARU	50057	17	686	1	15319	31	47273	94	12650	25	64	0
9		TANAH LAUT	10260	27	292	3	0	0	8902	100	130	1	1455	16
10		TAPIN	12123	84	0	0	293	2	12123	100	84	1	0	0
11		TABALONG	8902	6	0	0	1440	16	8328	94	203	2	6862	77
12		TANAH BUMBU	23590	12	464	2	13024	55	23588	100	1178	5	8559	36
13		BALANGAN	153	0	0	0	1	1	153	100	0	0	0	0
South Kalimantan in total			**125668**	**15**	**1442**	**1**	**32953**	**26**	**120453**	**96**	**14257**	**11**	**17830**	**14**
14	East Kalimantan	KUTAI TIMUR	95497	9	2644	3	33355	35	0	0	3720	4	0	0
15		BERAU	132741	18	2257	2	73414	55	0	0	12286	9	0	0
16		KUTAI BARAT	67436	5	644	1	38586	57	0	0	5223	8	0	0
17		PASER	86726	14	931	1	28462	33	0	0	4042	5	0	0
18		BALIKPAPAN	195	3	0	0	13	7	0	0	0	0	0	0
19		TARAKAN	2624	28	0	0	731	28	0	0	0	0	0	0
20		KUTAI KARTANEGARA	58222	9	523	1	13183	23	0	0	32	0	0	0
21		SAMARINDA	22	0	0	0	10	45	0	0	0	0	0	0
22		BULUNGAN	114275	22	14	0	70236	61	0	0	20771	18	3032	3
23		MALINAU	20877	3	113	1	7981	38	0	0	0	0	0	0
24		NUNUKAN	157746	23	512	0	107728	68	0	0	0	0	0	0
25		BONTANG	217	3	0	0	81	37	0	0	0	0	0	0
26		PENAJAM PASER UTARA	13166	12	0	0	0	0	0	0	1522	12	0	0
27		TANA TIDUNG	42822	24	139	0	20460	48	0	0	0	0	0	0
East Kalimantan in total			**792566**	**12**	**7777**	**1**	**394240**	**50**	**0**	**0**	**47596**	**6**	**3032**	**0**
28	SE Sulawesi	KOLAKA	21641	10	1525	7	9318	43	1842	9	1978	9	12006	56
29		KONAWE	1432	1	525	37	665	47	458	32	492	35	417	29
30		MUNA	1656	2	0	0	978	60	1138	69	351	21	431	26
31		BUTON	286	0	0	0	205	72	0	0	0	0	0	0
32		KENDARI	0	0	0	0	0	0	0	0	0	0	0	0
33		BAU-BAU	90	1	0	0	13	15	67	75	0	0	0	0
34		KONAWE SELATAN	6568	8	0	0	4427	68	2084	32	1113	17	499	8
35		KOLAKA UTARA	13789	12	237	2	4195	31	273	2	81	1	0	0
36		WAKATOBI	0	0	0	0	0	0	0	0	0	0	0	0
37		BOMBANA	1765	2	0	0	1332	76	449	26	135	8	0	0
38		KONAWE UTARA	7035	3	3996	57	5929	85	1429	20	2072	30	0	0
39		BUTON UTARA	3811	3	0	0	2407	64	3032	80	2419	64	3391	90
SE Sulawesi in total			**58073**	**5**	**6283**	**11**	**29469**	**51**	**10772**	**19**	**8641**	**15**	**16744**	**29**

Appendix R – The Proportion of Deforested Areas in Secondary Forest that Occurs in Potential Areas of Mining, Agriculture, and Crop Plantation

No	Province	District	Deforestation (Ha)	Deforestation (%)	The proportion of deforested areas in secondary forest that occurs in potential areas					
					Agriculture (Ha)	Agriculture (%)	Mining (Ha)	Mining (%)	Crop Plant. (Ha)	Crop Plant. (%)
1	South Kalimantan	BARITO KUALA	8270	80	1496	18	0	0	157	2
2		BANJARMASIN	0	0	0	0	0	0	0	0
3		BANJAR BARU	114	58	0	0	0	0	0	0
4		BANJAR	10474	11	2382	23	92	1	157	1
5		HULU SUNGAI TENGAH	440	1	0	0	0	0	0	0
6		HULU SUNGAI SELATAN	304	20	0	0	39	13	0	0
7		HULU SUNGAI UTARA	981	64	0	0	0	0	0	0
8		KOTA BARU	50057	17	4605	9	29127	58	6077	12
9		TANAH LAUT	10260	27	2224	25	1279	14	1674	19
10		TAPIN	12123	84	7508	62	71	1	2	0
11		TABALONG	8902	6	0	0	2175	24	0	0
12		TANAH BUMBU	23590	12	5596	24	6766	29	0	0
13		BALANGAN	153	0	0	0	0	0	0	0
South Kalimantan in total			**125668**	**15**	**23811**	**19**	**39549**	**31**	**8067**	**6**
14	East Kalimantan	KUTAI TIMUR	95497	9	4683	5	51263	54	13368	14
15		BERAU	132741	18	10438	8	62048	47	37420	28
16		KUTAI BARAT	67436	5	7749	11	57080	85	23767	35
17		PASER	86726	14	18649	22	25608	30	19389	22
18		BALIKPAPAN	195	3	1	1	85	44	48	25
19		TARAKAN	2624	28	1104	42	769	29	620	24
20		KUTAI KARTANEGARA	58222	9	432	1	36894	63	2379	4
21		SAMARINDA	22	0	8	36	22	100	12	55
22		BULUNGAN	114275	22	17944	16	29475	26	30284	27
23		MALINAU	20877	3	1958	9	1673	8	2340	11
24		NUNUKAN	157746	23	37834	24	71543	45	24364	15
25		BONTANG	217	3	16	7	53	24	61	28
26		PENAJAM PASER UTARA	13166	12	1116	8	7641	58	1838	14
27		TANA TIDUNG	42822	24	6797	16	354	1	5160	12
East Kalimantan in total			**792566**	**12**	**108729**	**14**	**344508**	**43**	**161050**	**20**
28	SE Sulawesi	KOLAKA	21641	10	23	0	1525	7	668	3
29		KONAWE	1432	1	82	6	525	37	190	13
30		MUNA	1656	2	0	0	0	0	64	4
31		BUTON	286	0	0	0	0	0	10	4
32		KENDARI	0	0	0	0	0	0	0	0
33		BAU-BAU	90	1	9	10	0	0	0	0
34		KONAWE SELATAN	6568	8	25	0	0	0	72	1
35		KOLAKA UTARA	13789	12	3	0	237	2	18	0
36		WAKATOBI	0	0	0	0	0	0	0	0
37		BOMBANA	1765	2	0	0	0	0	0	0
38		KONAWE UTARA	7035	3	206	3	3996	57	650	9
39		BUTON UTARA	3811	3	0	0	0	0	8	0
SE Sulawesi in total			**58073**	**5**	**348**	**1**	**6283**	**11**	**1680**	**3**